Energy Collaborative Analysis Workshop
June 20-21, 2006
Washington, DC

Outcomes Document

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For the U.S. Department of Energy's
Energy Efficiency and Renewable Energy Office and
The Workshop Planning Committee

Energy Collaborative Analysis Workshop Outcomes

EXECUTIVE SUMMARY

The Office of Energy Efficiency and Renewable Energy (EERE) at the U.S. Department of Energy (DOE), in conjunction with a multi-organizational Planning Committee, convened a workshop for federal and state officials and research organizations to identify opportunities to enhance collaboration on energy analysis, in order to inform and drive policy making. Such collaboration can make analysis more efficient and cost effective and can increase credibility by improving analytical methods, developing standardized assumptions and methodologies, and producing better results for decision-makers. The Planning Committee designed the workshop to inform the direction of analysis to answer policy maker questions, so that they can use analysis to develop sound policies that achieve multiple objectives simultaneously. In order to do so, the workshop allowed energy analysis leaders to identify priority energy analysis issues over the next 5 years, immediate common analysis needs along with steps we can take to collectively address those needs, and efficient mechanisms to promote ongoing energy analysis coordination and information sharing. 62 analysts from 27 different organizations participated in the June 2006 workshop.

Vision – High Priority Energy Analysis Issues

Participants at the workshop identified high-priority energy issues for both analysts and decision-makers that should be addressed in the next 5-10 years. Several common themes emerged:

- Improve models representation of complex and disjointed **policy frameworks**, and **technology deployment**; enhance tools to better analyze actual policy opportunities and market influence
- In analysis, augment reflection of **behavioral factors** that influence consumer, supplier and investment decisions (particularly for transportation and end-user consumer decisions)
- Develop methods to capture **uncertainty and risk analysis** in current modeling; they are critical to the potential effectiveness of a policy or the impact on the market and must be modeled better.
- Increase energy model **comprehensiveness and/or stronger linkages** to better represent market complexities and to understand the total projected impacts/value of energy.

Immediate Collaboration Opportunities

Eight priority energy analysis topics that could inform decision makers were discussed and collaboration activities were developed (below). Lead and participating organizations were identified for most activities. Next steps include assessments of existing tools/data, convening topic-specific web-forums and workshops, improving methodologies, and making analysis results accessible to decision-makers.

1. Enhance Research, Development and Deployment Portfolio Analysis Tools (3 activities)
2. Improve Deployment Partnerships between Industry and Government (4 activities)
3. Augment Energy Technologies and Demand Response Representation in Energy Models (4)
4. Enhance Regional Tech. Characterizations and Transmission Constraints in Energy Models (3)
5. Improve Impact Evaluation Tools: Economic Development, Energy Security, Env. Impacts (4)
6. Improve Policy Analysis Tools and Integration of Data and Tools at State and Federal Levels (3)
7. Enhance Biofuel Resource Potential and Infrastructure Analysis (2)
8. Improve Behavioral Factors in Market/Choice Models and Tools (3 = 26 activities total)

Steps to Promote Ongoing Coordination and Communication

To promote ongoing analysis coordination, a number of communication means were identified. DOE will work with the participating organizations to develop and launch, as appropriate, the following activities:

- A centralized website to house a variety of materials, potentially including documents used as background for the workshop, descriptions of each organization's energy analysis activities and data, information, analysis methodologies and models/tools under the topics of interest
- Monthly, interactive web forums that focus on particular topics that fit within the eight topics. These will be interactive and will explore different ways to analyze a topic and allow for discussion of analyses under development
- A monthly electronic newsletter that highlights the status of current activities and provides the web forum schedule going forward,
- Potentially, the coordination of annual workshops

This document provides more details of outcomes from the June workshop in the areas described above.

Table 1. Summary of Specific Energy Analysis Activities, by Topic

	Workshop Topic	Activity #1 (Lead)	Activity #2 (Lead)	Activity #3 (Lead)	Activity #4 (Lead)
A	**Enhance R&D and Deployment Portfolio Analysis Tools**	Identify existing tools and the current framework for analysis; share in web forum (**NREL**)	Create a Portfolio Analysis Center (clearinghouse of info. and tools); kick-off meeting (**DOE-OSc.)**	Identify standards of excellence for including risk, value and uncertainty in portfolio analysis **(DOE-EERE)**	
B	**Improve Deployment Partnerships between Industry and Government**	Call to ID current work; Evaluate successful R&D-Deployment models; scoping paper to capture best practices; consider workshop **(NYSERDA, CESA)**	Incorporate deployment into R&D planning; Develop best practices checklist (from #1) on deployment methods and decision tools **(DOE-EERE /NREL)**	Improve policy mech. and state-federal links; DOE consider inviting states into planning, sending staff for state plans **(DOE-EERE, DOE-OSc.)**	Communicate with intended users of info.; develop common definitions and focus results on audience (surveys, interviews and focus groups) **(Needs leader)**
C	**Better Representation of Energy Technologies and Demand Response in Energy Models**	Gather empirical info on evolution of technologies and markets; create tech. maturation and saturation curves; develop tech. characterizations **(NREL, NETL)**	Quantify the potential for new/emerging technologies; clarify terminology; consider incorporation of new tech into models **(DOE-EERE/NREL, DOE-EIA)**	Develop new empirical work on demand elasticities; start with call to scope out work; incorporate new data into models **(DOE-EERE)**	Improve the link between data-producers and model developers; EPA July workshop on tech. changes in modeling; communicate results **(EPA)**
D	**Better Representation of Regional Technology Characterizations and Transmission Constraints in Energy Models**	Inventory existing analysis/ modeling capabilities of organizations, incl.: strengths and weaknesses **(DOE-EERE, NETL)**	Share existing GIS datasets, if not proprietary; for proprietary, negotiate multi-party purchase **(DOE-EERE)**	Call to examine regionality and trans. improvements currently underway in SEDS, NEMS; sensitivity across models **(NREL, DOE-EIA, NETL)**	
E	**Improve Impact Evaluation Tools: Economic Development, Energy Security, Env. Impacts and the Integration of the Three**	Create a model inventory (econ dev, energy security, env. Impacts) and identify strengths/ limitations of each **(ACEEE)**	In report/paper, a full accounting of impacts and identify different methodologies; hold impact eval workshop; build central website **(ACEEE, NREL)**	Identify critical economic factors; hold workshop to define appropriate relationships between factors for use in models **(ACEEE)**	Build upon model inventory (#1), identify models that need validation; for these, develop validation method; conduce validation **(Needs leader)**
F	**Improve Policy Analysis Tools and Integration of Information and Tools at State and Federal Levels**	Identify and share existing information, tools and resources; e-mail listserv to communicate **(DOE-EERE, NREL)**	ID lessons learned, develop common methodology; convey applicability of policy tools and impacts for decision-makers **(DOE-EERE, EPA-Dan Loughlin)**	ID a way for state and federal modelers to speak regularly; ID/create regional models for state policy issues **(Needs leader)**	
G	**Enhance Biofuel Resource Potential and Infrastructure Analysis**	ID current efforts; coordinate consistent, vetted biomass supply curves **(NREL)**	DOE share biomass transition model (July 06 meeting); ID new data, ways to improve model **(NREL)**		
H	**Improve Behavioral Factors in Market/Choice Models and Tools**	Meeting to discuss next steps; survey about existing data/models; **(DOE-OSc.)**	Compare analytical methods and identify best practices; ID new data sources **(DOE-OSc.)**	Help OSTP direct NSF funds; convene a behavioral specialist workshop **(DOE-OSc.)**	

(1) Introduction

Overview
The Office of Energy Efficiency and Renewable Energy (EERE) at the U.S. Department of Energy (DOE) in partnership with a multi-organizational Planning Committee would like to develop and enhance collaborations among key organizations active in analyzing energy markets, policies, and portfolios, in order to inform and drive policy making. Modeling and analysis are useful to the extent that they provide answers to questions posed by decision makers, or proactively inform policy makers of the questions they should be asking in order to develop sound policies. Through the development of a shared strategy for addressing high priority energy analysis issues, the DOE and the other members of the Planning Committee hope to gain synergies, minimize duplication, improve analytical methods, develop standardized assumptions and methodologies, and produce better analysis tools and results for decision makers. We hope that collaboration will allow energy analysts to leverage their analysis budgets so that we can improve the scope, accuracy, and impact of energy analyses.

Background
To facilitate analysis collaboration that could best inform decision making, the Planning Committee decided to hold a workshop, where relevant analysts could identify specific energy analysis goals and activities. DOE/EERE's Planning, Evaluation, and Analysis (PAE) Division volunteered to sponsor the workshop. The Planning Committee guided initial workshop planning by (1) identifying potential energy analysis topics, (2) formulating a set of goals and a structure for the workshop and (3) identifying high priority analysis topics on which to focus initial collaboration activities. The Planning Committee met twice and provided substantial direction – organizations represented in the committee are listed in Appendix 1.

First, the Planning Committee laid out the audience and goals for the U.S. Energy Analysis Collaborative Workshop. They decided to initially focus on critical analysis issues that could best inform policy makers and to only include analysts from those organizations that are the key funding sources of energy analysis, namely federal agencies, states, and research organizations. Additional collaborators could be brought in once this group decided what was of most importance to them and their decision makers. Next, they identified the goals for the workshop and for this collaborative project:

- Identify a few high priority energy analysis topics to serve as the focus of initial collaborative work in FY06, with the opportunity to broaden the focus in FY07.
- Identify ways to balance between the multiple objectives of decision-makers – namely fairly-priced energy, a cleaner and healthier environment and economic development
- Develop and initiate implementation of a work plan for a few collaborative projects that will be undertaken for each of these high priority energy analysis topics
- Identify additional topics and projects for which the participating organizations invite collaboration and promote exchange of information on possible steps for these topics
- Define approaches for ongoing dialogue and sharing of energy analysis information, tools, and results among energy analysis practitioners
- Identify ways to communicate results to appropriate decision-makers.

In order to properly prepare for the workshop, the Planning Committee recommended conducting a number of decision-maker and analyst interviews, as well as some supplemental research. The goal of gathering this information was to discover top priority energy issues across both decision-makers and analysts, and to clarify information needs/gaps. Their input was consolidated into an integrated matrix, comparing decision-makers and analyst energy analysis priorities. These were discussed at the Planning Committee meeting in May and were ranked, in order to identify the top priority analysis activities for the breakout sessions of the Collaborative Energy Analysis Workshop, using the following criteria:

- Where do the needs and interests of decision-makers and analysts intersect on energy analysis?
- What energy issues/analysis activities were self-identified as important yet not addressed to a critical mass of participating organizations (i.e. which attracted the most diverse groups of decision-makers and/or analysts)?

- Are current information, tools and models inadequate to address this issue?
- Is there a discrete, actionable activity to address this issue/question?
- Can a collaborative effort of multiple organizations provide additional value through 1) collaboration on scope (to identify specific activities for different parties to perform), 2) leveraging of resources and capabilities, and 3) sharing of information and results

Based on the goals of the collaboration, the Planning Committee decision criteria and the results from the decision-maker and analyst interviews, the committee identified the seven analysis topics that they felt were of highest priority. These topics were then selected as main topics for the breakout sessions of the workshop. In addition, the workshop participants were encouraged to consider any additional topics that met the above criteria and that were high enough priority to deserve discussion; one was identified. The eight topics are:

1. Enhance Research, Development and Deployment Portfolio Analysis Tools
2. Improve Deployment Partnerships between Industry and Government
3. Augment Energy Technologies and Demand Response Representation in Energy Models
4. Enhance Regional Tech. Characterizations and Transmission Constraints in Energy Models
5. Improve Impact Evaluation Tools: Economic Development, Energy Security, Env. Impacts
6. Improve Policy Analysis Tools and Integration of Data and Tools at State and Federal Levels
7. Enhance Biofuel Resource Potential and Infrastructure Analysis
8. Improve Behavioral Factors in Market/Choice Models and Tools (identified during the workshop)

Workshop

The workshop had 62 analysts from 27 different organizations, who are listed in Appendix 2.

The Planning Committee designed the workshop to focus both on long-range as well as short-term energy analysis decision-making opportunities. During the first morning session, participants identified priority energy analysis issues over the next 5 years – it was during this session that an additional breakout session topic was identified. The next section of the workshop concentrated on the 8 topics selected by the Planning Committee and workshop participants. Each was discussed in detail during concurrent sessions in order to confirm immediate, common analysis needs and participants developed action plans with steps that we can take to collectively address those needs. One important task for each topic was to clearly identify strengths and weaknesses of various models and analysis methodologies, in order to identify appropriate models to drive decision-making. The final section of the workshop identified efficient mechanisms to promote ongoing energy analysis coordination and information sharing. 26 immediate collaboration activities were identified during the workshop breakout sessions. Collaboration has already begun on several activities, through phone calls or initial meetings.

Process Going Forward

To promote ongoing coordination, a number of communication means were identified, which DOE and other participating organizations are developing further. Key communication mechanisms include:

- A centralized website to house a variety of materials, potentially including documents used as background for the workshop, descriptions of each organization's energy analysis activities and data, information, analysis methodologies and models/tools under the topics of interest
- Monthly, interactive web forums that focus on particular topics that fit within the eight topics. These will be interactive and will explore different ways to analyze a topic and allow for discussion of analyses under development
- A monthly electronic newsletter that highlights the status of current activities and provides the web forum schedule going forward,
- Potentially, the coordination of annual workshops,
- Other mechanisms as are deemed appropriate.

This document identifies the outcomes from the workshop, including the 5 year vision of energy analysis issues of importance, specific short-term activities on which the group could collaborate and identifying communication activities.

(2) Summary of Communication and Coordination Activities

There are a number of activities that should be explored to facilitate collaboration and coordination on energy analysis activities resulting from the Energy Collaborative Analysis Workshop. DOE-EERE is committed to providing some initial and ongoing support to help facilitate collaboration as our relationships form. The activities to which DOE has committed resources are listed in the first section below. Additional recommendations were made at the Workshop, which are also detailed below. Please let us know if you are willing and able to advance one or more additional communication activities. And as always, we would greatly appreciate hearing any other suggestions.

DEPARTMENT OF ENERGY – EERE SPONSORED ACTIVITIES
Communication and Coordination Activities
To promote ongoing coordination, a number of communication means were identified, which DOE and other participating organizations are developing further. Key communication mechanisms that DOE has committed to support include:

- A centralized website to house a variety of materials, potentially including documents used as background for the workshop, descriptions of each organization's energy analysis activities and data, information, analysis methodologies and models/tools under the topics of interest
- Monthly, interactive web forums that focus on particular topics that fit within the eight breakout session topics. These will be interactive and will explore different ways to analyze a topic and allow for discussion of analyses under development (similar to ABA and EPA forums)
- A monthly electronic newsletter with headlines upfront that highlight the status of current activities and provides the web forum schedule going forward
- Potentially, the coordination of annual workshops. Discuss specific topics and have organizations do presentations on their analysis activities, or a particular activity to share tools, information and analysis methodologies.
- Consider creating a leadership committee to help guide the overall collaboration process
    - Initially, composed of the leaders of the various activities
        - Goal is to maintain momentum from the workshop and encourage engagement
    - Schedule one meeting before December 2006.
        - Create detailed agenda for the meeting
            - Quick updates on activities (3-4 sentences each)
            - What coordination and collaboration activities are needed for success?
            - Topics for web forums – input on speakers, topics
            - Consider annual workshop?
        - Ask participants:
            - Should the energy analysis planning committee hold regular meetings?
            - If so, how frequently?
            - Would you help us put together an agenda for an annual workshop? (speakers, topics, etc.)
            - How should we consider incorporating additional topics, beyond the 8 from the original workshop?

ADDITIONAL ACTIVITIES FOR CONSIDERATION
Tools for Collecting and Disseminating Information

- Conference calls to update each other on our activities. Need to focus on specific area of focus; agenda with timetables and milestones.
- Centralized, facilitated website, similar to Wikipedia; issue – needs a champion
- Informational e-mail listserv. Use the Green Power model – e-mail on a monthly basis that shows the studies completed and a link to the study; someone calls once a month to report on what they are doing.
- Question e-mail listserv. If you need some help on an analysis, or want to check assumptions and are not sure who can help, e-mail a set of experts who are willing to answer questions and

provide input; perhaps have this facilitated to target the right folks. AESP has this on their website – perhaps find a way to leverage existing ones

- Committee to forecast energy technology progress. Follow the example of www.TECHCAST.org – this is a "virtual: think-tank that highlights 60 technologies every 6 months and creates an estimate of when they think each will hit 30% market share and how quickly. Perhaps it would make sense to create our own expert committee that can do the same on energy technologies – we can map out the results to show what the group is thinking about particular technologies. This could be web-based, and something like a virtual Delphi forum
- Capture existing analysis activities. Start by creating short-summaries of what each agency is doing – look across all the agencies to identify activities and common interests. Capture on a central website – different types of analysis that different entities are doing on a particular topic, a description of the study, the results and a contact
- Share access to data. Identify ways to share access to data – if we all buy specific databases, can we find a way to make it contractually available to our partners?
- Take advantage of regular annual meetings –
    - ACEEE Summer study – spend a week presenting papers, dialogue. Other conferences too – perhaps use these times to build relationships.
    - International Energy Program Evaluator Conference,
    - Association of Energy Service Professionals.
    - Coalition of Northeast Governors has an Energy Working Group. They e-mail each other once/week to brief each other on what is going on.
    - IEEE – wind power coordinating committee; collaborate with other technical organizations
- Create an "Adversarial Collaborative;" allows for honest critiques of our analysis by those who may not be in our "camp"

Planning Process

- Recommendation: EERE could set aside a specific percentage of budget to support expert staff exchanges
- Use the monthly newsletter as a tool to help facilitate the planning process
- Identify communication mechanisms for getting analysis results to decision makers; implement
- Organizations with big analysis budgets should coordinate their analysis activities annually, as part of the budget cycle (spring to hit federal cycle, Feb-Apr to include California)
    - Regular, annual analysis. Explain basic analytical capacities to each other – those things that we plan to do on an annual basis
        - NYSERDA performs a good deal of analysis annually
        - EIA does as well (e.g. incremental model improvements and annual projections)
    - Ad hoc analysis. As these surprise analysis activities are raised, collaborate
        - NY – special studies at the request of the Governor or legislature (case by case); they can be 12-24 month projects;
        - EIA – Similarly, they get Congressional requests
        - Perhaps have mechanism to "peer review" or coordinate on ad hoc analysis
- In addition to annual planning, consider 1-5 year analysis and budget planning in agencies.
    - To support longer-term planning, perhaps make technical support available (in the form of either dollars, or consultants such as SAIC, ICF, Navigant) over a 3-year period. Allow other agencies and states to access them.

Collaboration Participation – a Few Thoughts

- Perhaps have things be ad hoc at first so that people who want to participate will do so using the tools that make sense for them. Those that have the most mutual interest will survive.
- Deliver accessible forms of analysis to external stakeholders to answer the many questions decision-makers have on clean energy issues. Analysis must be simple, must include implications of particular actions to help with policy decisions. Potential audiences: NCSL, NARUC, NGA. One good example are the LBNL case studies done for CESA
- Find a way to get information to states that do not have resources

(3) Summary of Energy Analysis Vision

At the beginning of the Workshop, the participants considered priority energy analysis issues that would benefit from collaborative analysis over the next five years. Recommendations were developed for: 1) Electricity 2) Transportation and 3) Energy Efficiency and Demand-side Generation. Each group was also charged with the responsibility of identifying cross-cutting issues that deserve attention.

Some common themes emerged across each of the three groups in thinking about priority analysis needs that might benefit from collaboration over the next five years.

1. Need improved analysis of policy frameworks; interactions with technology deployment.
To better understand and predict the technology choices under different policies, Workshop participants thought it was important to develop analysis tools that accurately simulate the complex and sometimes disjointed policy framework. Likewise, there was support for achieving a better understanding of what policy approaches are most effective so this could be applied to analysis of the policy impacts in the future, such as what incentive levels are required to make a project viable? This can be extended to research and development (R&D) portfolio management – there is a need for more information on which R&D investments have been the most successful in the past and why?

2. Better ways to reflect and analyze behavioral factors that influence consumer, supplier and investment decisions.
Analytical tools should be improved to more closely model real life consumer and investor decisions. The challenge will be to capture the serial nature of decision making and the effect of feedback that influences each step of the decision chain. For instance, a better understanding of utility decisions, such as how they are planning for carbon management, could improve forecasts of technology choices. We should not assume all decisions are analytically rigorous, and pointed out that the regulatory environment plays an important role that is not captured in many models. There also may be empirical data that could help inform analysis about consumer and investor behavior, but we need better mechanisms to synthesize and share that information with analysts.

3. Policy decision makers and energy analysts need a better understanding and better approaches to uncertainty analysis.
Although the participants of these groups recognized that the National Energy Modeling System (NEMS) and other macro level energy models use alternative cases to reflect the uncertainty in forecasts, they saw a need to better interpret the probability of those scenarios and the factors that contribute to the uncertainty. Better ways to analyze risk and better characterization of risk factors would help as well. These improvements might help decision makers answer questions such as how uncertainty around fossil fuel prices and carbon markets might impact the technology choices and cost of electricity.

4. Energy models need to be more comprehensive and/or have better linkages to better represent market complexities and to understand the total projected impacts/value of energy.
There is a perceived need for models to evolve to better represent the complexities of the current energy systems in ways that allow for direct comparison of multiple attributes of energy choices. For instance, modeling tools should use standardized metrics and capture a broad spectrum of impacts including costs, reliability, equity, environmental impacts (including water), and economic development impacts. There is a need for improvements in electricity system models to better simulate the complexities of the regional transmission system and contract-based markets. Models should be capable of incorporating the full supply chain, cross–sector analysis and to look at the interplay between the various demands in different sectors. Current models rely on oversimplified characterization through averages and prototypes and should be improved to rely more on probabilistic and agent-based modeling that better capture a distribution of responses.

In addition to these shared visions of the priority analysis needs and opportunities for collaboration over the next five years, each of these Workshop groups generated a number of other suggestions. You can read the full reports of the Vision Sessions in Appendix 3.

(4) Summary of Outcomes from Breakout Sessions – Immediate Areas for Energy Analysis Collaboration

This section summarizes the activities resulting from the topic-specific breakout sessions, including the goals, current related activities, next steps identified, the lead and the other participants. If anyone reading this would like to be included in the participant list, they should contact Karlynn Cory at NREL in order to be added to the participant list for a particular activity (Karlynn_cory@nrel.gov, 303-384-7464). Additional detail of the discussion of each breakout session can be found in Appendix 4.

Common Themes

Despite the fact that the eight main energy analysis topics were discussed concurrently in two different sessions, there were several common, basic needs that emerged. And interestingly, these basic needs tended to focus on some common information and analysis needs of analysts, the linkages between state and federal analysis, as well as the translation of results to decision-makers, no matter what specific topic was discussed. Therefore, one might speculate that these needs should be considered even for analysis topics outside of the eight discussed. The basic needs that emerged were:

- We need a common language, and should **agree upon definitions** for the terms we use, so they are used consistently by all analysts
- States are not currently engaged as much as they should be in federal analysis and decision-making. We should create a stronger **link between state and federal analysis**
- There is a lot of data out there, but it is not centrally located. A **central clearinghouse** of current information, models and/or tools would be extremely helpful, especially to states who do not have resources to gather all of the information
- We should **peer review and verify** modeling methodologies
- **Best practices** should be identified, because it is not always easy for other analysts or especially decision-makers to understand how they should interpret and apply the results of energy analysis
- Analysis and results need to be **accessible to decision-makers** at high and low levels – we need to create tools that are transparent and easy to use and understand. Results always need to be clearly explained.
- **All impacts should be captured** (not just cost), including economic development, env. impacts, security, health impacts, reliability improvements

(A) Enhance R&D and Deployment Portfolio Analysis Tools

Activity #1 – Identify existing tools for analysis

- Goals: Develop a better picture of existing data and analysis to improve analysis going forward
- Current related activities: Many R&D and deployment portfolio analysis activities going on (DOE, EPA?, DOD?, states), using many different tools (SEDS, MARKAL, NEMS, etc.)
- Next steps: (1) NREL (with DOE) is conducting an assessment of existing data and analysis tools for portfolio analysis and recommendations for improvements in these tools; and (2) NREL could share results of this assessment with interested organizations during a conference call and identify opportunities to work together to improve these tools and share methods.
- Lead: NREL
- Participants: EPA, states

Activity #2 – Create a Portfolio Analysis Center

- Goals: Need to review options for establishing a permanent portfolio analysis capability
    - Needs to be independent to have credibility
    - Peer review is critical of Center's work

- Current related activities: (1) Laboratory Working Group (between DOE National Labs) had similar activity and perhaps could share their best practices with the group; and (2) NYSERDA's analysis shop may be a model
- Next steps: Convene meeting where approaches to portfolio analysis are shared across organizations (including NYSERDA's integrated approach, recommendations from DOE's laboratory working group (LWG), DOE Office of Science portfolio recommendations, etc.).
- Lead: DOE – Office of Science – Bill Valdez
- Participants: DOE National Labs, NYSERDA

Activity #3 – Identify standards of excellence for portfolio analysis
(no discussion; ran out of time – so below are all suggestions for consideration by the key participants)

- *Goals: Increase consistency of information and analysis methodology in portfolio analysis*
- *Current related activities: Activity #1*
- *Next steps: (1) During the conference call in Activity #1 and 2, discuss the opportunity to work on portfolio analysis excellence standards; (2) If group decides to move forward with such standards, work to identify current practices for portfolio analysis assumptions, information and analysis methodology; (3) Identify best practices for addressing risk, value and uncertainty when doing portfolio analysis; and (4) communicate to other interested parties.*
- *Lead: DOE-EERE-PAE*
- *Participants: NYSERDA, DOE national labs, DOE - Science*

(B) IMPROVE DEPLOYMENT PARTNERSHIPS BETWEEN INDUSTRY AND GOVERNMENT

Activity #1 – Identify and Evaluate Successful R&D-Deployment Models

- Goals: (1) Identify current R&D-deployment activities; what works and what doesn't when trying to link the two; and (2) improve the working relationships between states, DOE, Laboratory technology transfer and STAC (ASERTTI)
- Current related activities: (1) NYSERDA multi-year market plans; (2) CESA member multi-year market planning; (3) DOE-EERE multi-year market planning.
- Next steps: (1) Hold a conference call to discuss existing work in this area done by DOE-PAE and other parties – need to consider a) market implications beyond cost (e.g. barriers) and b/ market transformation; (2) Create a scoping paper to identify best practices of linking R&D to deployment (brief inventory of programs, issues, approaches); and (3) Discuss scoping paper findings in a meeting/conference call and consider holding a workshop
- Lead: CESA – Mark Sinclair, NYSERDA – Paul DeCotis
- Participants: CEC, DOE-PI, PNNL, NETL, states, national lab tech transfer offices, STAC/ASERTTI and SEO

Activity #2 – Incorporate Deployment into R&D Planning

- Goal: Identify potential methods for incorporate best practices of deployment into R&D planning.
- Current related activities: DOE-EERE attempts to consider deployment during their budgeting process
- Next Steps: (1) Drawing on the best practices identified in step 1, develop one or more Best Practices checklists on (a) deployment methods (including barriers) and (b) decision tools for use in R&D multi year planning
    - Should include government's own policy mechanisms – standards, tax incentives, voluntary programs, etc.
    - Cross-link this with Portfolio Planning breakout group
- (2) EERE could offer to pilot-test the checklist(s) in its own budget process (PAE could tie into guidelines for the multi-year planning process)
- Lead: DOE-EERE-PAE / NREL
- Participants: EPRI, CEC, NETL, CESA

Activity #3 – Improve Policy Mechanisms and State-Federal Linkages

- Goal: DOE could help to improve state-federal linkages on RD&D
- Current related activities:
- Next steps: (1) DOE will explore inviting states to participate in front-end DOE RD&D planning (and pay for state travel and time); (2) Send appropriate DOE staff to participate in state RD&D planning; and (3) Support demo projects on deployment by DOE and states
- Lead: DOE – EERE and DOE – OSc. - Bill Valdez
- Participants: CEC, CESA, NREL – invite NASEO and ASERTTI

Activity #4 – Communicate with Intended Users of Information

- Goals: (1) Solicit feedback from intended users of information – ask them: Does this make sense? Is the information accessible? Is the information consistent?; and (2) Identify how much effort and monetary resources would be needed to create information on R&D portfolio analysis. Can we avoid duplication of effort?
- Current related activities:
- Next steps: (1) Develop common definitions – where are clearer definitions and terminology needed? (e.g. Zero energy, demand response); (2) Narrow the scope to focus on each of the different audiences separately, at first (not energy topics) to make the effort more manageable using surveys, interviews and focus groups; explore website and hotline usage data
- Lead: **NEEDS LEADER**
- Participants: ??

(C) Better Representation of Energy Technologies and Demand Response in Energy Models

Activity #1 – Better Understand the Evolution of Technologies and Markets

- Goal: Learn from history to help with modeling the future
- Current related activities: (1) DOE Technology characterization of energy efficient and renewable energy technologies; and (2) NETL has Technology Characterizations (TC) for fossil energy efficiency and electricity generating technologies; (3) Federal government GPRA analyses; (4) market assessments being done by lots of organizations; and (5) states are heavily involved in deployment within their borders.
- Next steps: (1) Gather actual, empirical examples of historical:
    - Rates of technology change (cost, performance)
    - Identify the underlying dynamics and drivers
    - For all stages of tech. development – emerging, pre-commercial and commercial
    - How has the global market impacted technology evolution?
- (2) Share existing technology characterization methods and results and develop common approaches for maintaining current market assessment information.
- (3) Incorporate findings into technology maturation and saturation curves in models
- (4) Perform more complete technology characterizations; more than a catalogue – look at historical changes over time and look to the future; how and why things change
    - Separate out improvements due to R&D and improvements due to learning
- Lead: NREL (Walter Short: TC for energy efficiency and renewables), NETL (TC for fossil), NREL (market assessment)
- Participants: DOE-EIA

Activity #2 – Quantify the Potential for New/Emerging Technologies

- Goal: Identify clear parameters for when new/emerging technologies should be included in modeling
- Current related activities: (1) EERE's VISION model is specifically designed to answer "what if" questions in the transportation sector; (2) Stanford Modeling Forum is active in this area

- Next steps: (1) For collaboration potential, ask two questions:
    - Who else does modeling (e.g., states, utilities, US and international groups for climate change)
    - Who is a current (or potential) source of technology data
- (2) Clarify/define the terminology to get everyone on the same page; (3) Develop a screening criteria in order to Identify a way to consider substitute energy technologies and other competitors in energy modeling, before they are fully commercial, so future scenarios can be modeled; and (4) Also, scan the horizon and identify potential new technologies early (outside US too)
- Lead: DOE-EERE-PAE, DOE-EIA – Chris Namovicz
- Participants: ??

Activity #3 – New Empirical Work on Elasticities

- Goals: Update outdated work on price elasticities, because it is very important and impacts model results substantially. In doing so, need to distinguish between short-term and long-term elasticities, because they are very different
- Current related activities: (1) ORNL/David Greene is doing a lot on transportation market elasticities; (2) Goldman et al. for demand response; (3) California pilot projects attempted to define consumer demand; and (4) Workshop breakout session on behavioral response (H)
- Next steps: (1) Create a process to improve information on price elasticities for all energy technologies and demand response technologies in energy models (not specificity in the model); (2) incorporate the new data into the models (be sure to consider model incorporation from the start, to consider best form of information; ease of incorporation); (3) hold a call to discuss next steps
- Lead: DOE-EERE-PAE
- Participants: EPRI?, DOE-EIA, NETL?

Activity #4 – Improve link between data-producers and model developers

- Goal: Address the disconnect between data-producers and model-developers (and potentially model-users as well)
    - Some producers of data may make an effort to get the model [restructured to] to include their data.
    - But generally, there is far too little linkage between the two, and no effective way for data-users (esp. modelers) to "express their latent demand" for better data.
    - So instead of trying to come up with prescriptive solutions, maybe we should focus more on process reforms and rethinking relationships?
- Current related activities: EPA is having a forum next month on reflecting technology changes in modeling (Pete Wilcox, Alan Sanstad, others...)
- Next steps: (1) Attend EPA workshop; *(2) Identify missing participants (either data-producers or model developers); and (3) create a communication mechanism to begin to link the parties.*
- Lead: EPA – Allen Fawcett
- Participant: ??

(D) Better Representation of Regional Technology Characterizations and Transmission Constraints in Energy Models

Activity #1 – Inventory Existing Analysis/Modeling Capabilities

- Goal: Determine what tools are available now that are required for regional questions
- Current related activities:
    - Start from REMAP (renewable energy modeling analysis partnership) to assess what models and tools exist
    - For DOE, the Laboratory Working Group is a good place to start
    - EPA is investigating regionality in MARKAL – for REMI (jobs) and for RGGI (emissions)

    - NETL work on GEMSET (a model that looks at future cost of electricity, environmental outputs – includes all information about all power plants and demand loads); willing to lead coordinating its use collaboratively
    - Disaster planning and emergency services – NETL using GIS to identify best way to plan for energy impacts
- Next steps: (1) Create a comprehensive inventory the capabilities of tools, their strengths, weaknesses and capabilities of organizations
- Lead: DOE-EERE-PAE, NETL
- Participants: states, CESA, DOE labs, EPA

Activity #2 – Share Existing Data, if Possible

- Goal: Share GIS informational databases so we all have access to better, more comprehensive information
- Current related activities: Many organizations use GIS - it is an important tool for targeting decision-makers, because it provides easily understandable maps.
- Next steps: (1) share non-proprietary GIS databases. (2) For any that are proprietary, try to negotiate a multiple-entity purchase together (might require change in contracting)
- Lead: DOE-EERE-PAE
- Participants: NETL, states, EPA

Activity #3 – Examine Regionality and Transmission improvements in existing models

- Goal: Identify ways to improve regionality and transmission constraint representation in existing models
- Current related activities: (1) SEDS modeling, (2) NEMS is considering whether to continue to represent NERC regions, or if they should switch to RTOs
- Next steps: (1) Examine value of incorporating regionality into SEDS for sensitivity analyses, and cost-benefit trade off of good level of regionality vs. time to run the model (NREL and NETL)
- (2) Investigate whether NEMS should represent NERC regions or RTOs. What data changes are needed? Is this worth pursuing? (EIA, NREL, NETL, FERC)
- (3) Consider how best to capture the actual use of existing transmission lines in these models (NREL);
- (4) Hold a call to discuss the above three activities; perhaps later hold a web forum to discuss progress with states and other interested parties
- (5) Perform sensitivity analyses within a model and across models – explore sensitivity of which variables need uncertainty ranges
    - Michael Reed is getting trained on Analytica to operate SEDS
    - REMAP effort with respect to renewable portfolio standard (RPS) policies
- Lead: NREL – Walter Short, EIA – Chris Namovicz, NETL- Michael Reed
- Participants: FERC, states, CESA, others?

(E) IMPROVE IMPACT EVALUATION TOOLS: (A) ECONOMIC DEVELOPMENT, (B) ENERGY SECURITY, (C) ENVIRONMENTAL IMPACTS, (D) ALL THREE.

Activity #1 – Model inventory & best practices and identify strengths/limitations

- Goal: Create an inventory of models used for impacts analysis
- Current related activities: (1) Lots of models are being used – DOE-EIA/NEMS, EPA/MARKAL, states use NEMS and IPM; (2) Michael Leifman's Renewable Energy Modeling Forum is good place to start; (3) Jim Sweney (Stanford) put together 1990 assessment of current state of energy modeling, as part of National Energy Strategy under Admiral Watkins (Policy Office/EIA); and (4) AMIGA model looks at petroleum refiners
- Next steps: Create an inventory of models used for impacts analysis to cover (a) economic development, (b) energy security, and (c) environmental impacts
- Lead: ACEEE – Skip Laitner

- Participants: University of California, EPA, DOT, DOE, USDA, FERC, RTOs, HUD, PMAs

Activity #2 – Full Accounting of Impacts

- Goal: Develop methodologies to account for all of the impacts of a program or project, that goes beyond just the cost and the resulting energy savings
- Current related activities: (1) Lots of activities to quantify costs and energy savings – what about activities to quantify energy security, environment, health impacts, etc.? (2) Risk and consistent treatment of technology goals (different levels of technology optimism). Look at GWU site; they are using Delphi approach to examine
- Next steps: (1) Create a white paper, detailing current approaches to quantifying impacts analyses and pointing out the best practices, and areas where more analysis is needed.
- (2) Develop a workshop for Best Practices in Impact Evaluation
    - Identify potential sponsors and participants
    - Hold in the fall/winter of 2006
- (3) Create a collective website to share information (similar to Wikipedia)
- Lead: ACEEE – Skip Laitner, NREL
- Participants: University of California, EPA, DOT, DOE, USDA, FERC, RTOs, HUD, PMAs

Activity #3 – Define Appropriate Relationships of Economic Parameters in Models

- Goal: In many models, there is not always an appropriate relationship between economic parameters. This should be tested and corrected wherever possible
- Current related activities: (1) Lots of models are being used – DOE-EIA/NEMS, EPA/MARKAL, states use NEMS and IPM; (2) Michael Leifman's Renewable Energy Modeling Forum is good place to start;
- Next steps: (1) Assess relationship of critical economic factors used in models
    - Identify key relationships
    - Insure relationships make sense (e.g. price signal like carbon charge means prices go up and should have negative impact on GDP)
    - Check that feedbacks work as they should
- (2) Hold a best practices workshop to explore economic parameter relationships and models
- Lead: ACEEE – Skip Laitner
- Participants: University of California, EPA, DOT, DOE, USDA, FERC, RTOs, HUD, PMAs

Activity #4 – Validate Results of Evaluation Tools

- Goal: Evaluation tools may not yield appropriate results if they use faulty methodology – therefore they must be validated
- Current related activities: ??
- Next steps: (1) Building upon the model inventory (Activity #1), identify the models that need validation; (2) For these, develop appropriate validation method; and (3) Conduct validation exercise
- Lead: **NEEDS LEADER**
- Participants: ??

(F) Improve Policy Analysis Tools and Integration of Information and Tools at State and Federal Levels

Activity #1 – Identify and Advertise Existing Information, Tools and Resources

- Goal: Create a comprehensive list of information and tools for policy analysis
- Current related activities: (1) Many states and federal department use many different tools – these should be identified and shared (REMI-jobs, IMPLAN, IPM/electric sector, GE-MAPS, ADAGE, NEMS/national, MARKAL/national, Altos Management-1, VISION (DOE transportation), AMIGA, EPA exploratory modeling, RPA – USDA, state foresters inventory state forests,

HYTRANS – ORNL (national model hydrogen in vehicles), SMOKE and C-MAQ (air quality models); (2) Also many resources available (e.g. DOE Technical Assistance Program, EPA Clean Energy/Environment Program, etc.)

- Next steps: (1) Identify existing information, tools and resources available;
- (2) Share the information and tools on a website
- (3) Perhaps put together an e-mail listserv for communication
- Lead: DOE-EERE-PAE and NREL
- Participants: ?? Include environmentalists and industrials

Activity #2 – Improve Policy Analysis Modeling

- Goal: (1) Improve the quality of policy analysis modeling and make the tools and results accessible to more entities; and (2) Perform some specific model comparisons to help with decision-making:
    - A comparison of technology supply curves; how different are they?
    - Scenario analysis – at least 3 scenarios, if not stochastic
- Current related activities: (1) Activity #1 (Identify existing information tools and models) (2) Stanford energy modeling forum and (3) DOE-EPA Renewable Energy Modeling Forum; and (4) NYSERDA assesses national and state-side energy markets and informs stakeholders – other might be able to learn from their feedback process.
- Next steps: (1) Identify lessons learned from existing forums
- (2) Conduct a phone survey to understand decision-maker needs better;
- (3) Develop better technology-specific information to understand impact on big picture
- (4) Develop guidance on how to structure models (i.e. develop common methodology)
- (5) Especially for those without modeling capabilities, provide a clear and concise interpretation of applicability (by technology and region) and results at the decision-maker level, for each model and the results of any particular run, or set of scenarios;
- (6) DOE and EPA should help fund travel of state agencies with limited budgets
- Lead: DOE-EERE-PAE and EPA – Dan Loughlin
- Participants: ??

Activity #3 – Attempt to Integrate State and Federal Policy Analysis

- Goal: Strengthen national/state policy analysis personnel connection
    - Consolidation of DOE regional offices has created a gap
    - Federal offices need to remember to interface with states
- Current related activities: (1) DOE/EPA modeling forum (called REMAP) – next forum is focusing on modeling renewable portfolio standard (RPS) policies
- Next steps: (1) Identify ways for state and national analysts to speak about policy analysis on a regular basis
- (2) Identify/create regional models that speak to state issues
    - Linking models together is necessary to help states but difficult
    - This forum reinforces the significance of EPA's efforts to integrate models together
- Lead: **NEEDS LEADER**
- Participants: ??

(G) Enhance Biofuel Resource Potential and Infrastructure Analysis

Activity #1 – Consistent, Vetted Biomass Supply Curves

- Goal: collaborate to create consistent, vetted biomass supply curves
- Current related activities: There are several efforts underway to develop regional biomass supply curves, including: (1) ANL – GREET model vehicle and fuel technology options over a life cycle; (2) USDA – FASOM model looks at land use competition; (3) EIA; expand NEMS ability to deal with biomass, including supply curves; (4) NETL/FE – scenario/transition analysis of gasification and coal to liquids; (5) NREL – biomass model to address transition from petrol to biomass .

- Next steps: (1) Identify ongoing efforts and (2) coordinate multiple efforts to increase consistency and vet the regional biomass supply curves (Meeting in July 2006)
- Lead: NREL/John Sheehan (temporary)
- Participant: USDA – office of Energy, DOE-EERE-Biomass, DOE-EIA, DOE-EERE-PAE, USDA-USFS, USDA-Agricultural Research Service

Activity #2 – Evaluate DOE's Prototype Biomass Transition Model

- Goal: Peer review of DOE's prototype biomass transition model as a tool for developing strategies and exploring different timings of deployment
- Current related activities: (1) DOE developed a prototype biomass transition model that covers farmer and investment behavior in investing in a new biofuels supply chain and (2) USDA has identified new work needed to model farmer behavior/decision-making using the FASOM model
- Next steps: DOE will share the prototype model with interested parties to (meeting in July06):
    - Identify new sources of data
    - Look for ways to improve modeling methodology of transition
- Lead: NREL/John Sheehan (temporary)
- Participant: USDA – office of Energy, DOE-EERE-Biomass, DOE-EIA, DOE-EERE-PAE, USDA-USFS, USDA-Agricultural Research Service

(H) Improve Behavioral Factors in Market/Choice Models and Tools

Activity #1 – Document Federal Government Behavioral Factor Data and Models

- Goals: Identify existing data and models on behavioral factors
- Current related activities: (1) Several models are used by DOE, EPA, DOT – FERAM model on vehicle choices and decisions; (2) EIA actively monitors data availability and uses 3 classes of customers, based on previous equipment owned, but is cutting back on surveys (some entities will not sell data to EIA because they will lose customers; others allow data sharing – e.g. EIA piggybacks on ORNL vehicle data purchase from P.R. Polk (?)); (3) DOE-EIA funded ANL survey look at CENSUS (clearance issues due to freight sector); (4) DOE-Science conducting an OSTP workshop on how to understand factors between science and technology; also looking at the value of knowledge and (5) what activity is happening at the state level?
- Next Steps: (1) Set up a meeting to discuss next steps; and (2) Through survey (or other means) collect information about existing data and models.
- Lead: DOE-Science – Bill Valdez and DOE-EERE
- Participants: EPA, DOT

Activity #2 – Identify and Communicate Best Practices

- Goals: Compare data and model use and identify best practices
- Current related activities: see above
- Next steps: (1) Compare how different agencies use the information and perform analysis (methodology); (2) Identify best practices to improve modeling of behavioral factors (including incorporation of data into models; consider cost/benefit and appropriateness); and (3) identify other options for getting data – including using universities for surveys, behavioral research or collaboration with private sector (associations, companies)
- Lead: DOE-Science – Bill Valdez and DOE-EERE
- Participants: EPA, DOT

Activity #3 – Convene a Behavioral Specialists Workshop

- Goals: Bring together experts in the field to discuss data and tools and how to improve them
- Current related activities: (1) NSF asked for $7 million to do behavioral modeling (07 budget). (2) David Bornstadt doing some work for DOE-EERE-PAE; (3) Defense labs are doing some agent-

based work that might be helpful; and (4) Activity #1 – get picture of current data and models in order to know how to structure the workshop

- Next Steps: (1) Work through OSTP process to help direct NSF's funding; (2) Hold a meeting to begin planning the workshop, or perhaps a seminar series on consumer behavioral economics and behavioral factors.
- Lead: DOE-Science – Bill Valdez, OSTP, NREL
- Participants: DOT, DOE-EIA, DOE-EERE, DOD, EPA, National labs

Appendix 1. Energy Collaborative Planning Committee

Planning Committee Attendees

Name	Organization	Attended
Darrell Beschen	DOE/PAE	Yes
Scott Hassell	DOE/PAE	Yes
Brian Card	DOE/PAE	Yes
Doug Arent	NREL	Yes
Ron Benioff	NREL	Yes
Karlynn Cory	NREL	Yes
Catherin Morris	Keystone Center - Facilitator	Yes
David Terry	ASERTTI	Yes
Susan Holte	DOE/EIA	Yes
Joe Wilder	DOE/FE	Yes
Maria Vargus	DOE/FE	Yes
Poonum Agrawal	DOE/OE	Yes
Bill Valdez	DOE/OSc	Yes
Kevin Shaw	DOE/OSc	Yes
Steve Dunn	EPA-OAP	Yes
Tom Kerr	EPA-OAP	Yes
Mike Shelby	EPA-OTAQ	Yes
Sarah Dunham	EPA-OTAQ	Yes
Revis James	EPRI	Yes
Tom Key	EPRI	Yes
John Tantlinger	NASEO / HI SEO	Yes
Denise Swink	Indep.	Yes
Jeff Harris	LBNL	Yes
Bobi Garrett	NREL/PTM	Yes
Paul DeCotis	NYSERDA	Yes
Rick Weston	RAP	Yes
Bill Worek	ASERTTI/ U-IL @ Chi	Yes
Roger Conway	USDA	Yes

Invited - unable to attend

Art Rosenfeld	CEC	No
Dianne Turchetta	DOT-FHWA	No
Mike Savonis	DOT-FHWA	No
Art Rypinski	DOT-PO	No
Carlos Martin	HUD	No
Michael Freedberg	HUD	No
Hans Deitweiler	NASEO / IL SEO	No
Jeff Pillon	NASEO / MI-SEO	No
Diane Shea	NASEO	No
Peter Smith	NYSERDA	No
Hill Huntington	Stanford	No
Dub Taylor	TX-EO	No
Dan Kammen	UC-Berkeley	No

Appendix 2.
U.S. Energy Collaborative Analysis Workshop Participants

Doug Arent
NREL/SEAC

Bill Babiuch
Technology & Management Services

Sam Baldwin
DOE-EERE

Ron Benioff
NREL/SEAC

Darrell Beschen
DOE/EERE/PAE

Brian Card
DOE/EERE/PAE

David Chien
DOT/RITA/Transportation Statistics

Ed Coe
EPA-OTAQ

Kara Colton
National Governors Association

Roger Conway
USDA

Karlynn Cory
NREL/SEAC

Paul A. DeCotis
NYSERDA

Charles Drummond
NETL

Steve Dunn
EPA-OAP

Allen Fawcett
USEPA Headquarters

Robert Fireovid
USDA – Ag Research Service

Michael Freedberg
HUD

Bobi Garrett
NREL/SD&A

William Goldner, Ph.D.
USDA - CREES

Rich Halvey
Western Governors Association

Zia Haq
DOE-EERE – Bioenergy

Jeff Harris
LBNL

Scott Hassell
DOE/EERE/PAE

Susan Holte
DOE-EIA

Thomas Jenkin
NREL

Tom Key
EPRI

Jordan Kislear
DOE/FE/Office of Planning and Environmental

Peter Klemkowsky
NETL

Skip Laitner
American Council for an Energy Efficient Economy

Audrey Lee
DOE-POLICY

Michael Leifman
DOE/EERE/PAE

Dan Loughlin
U.S. EPA

John Maples
DOE-EIA

U.S. Energy Collaborative Analysis Workshop Participants (cont).

Lynn McLarty
Technology & Management Services

Darren Mollot
DOE/FE/Office of Planning and Environment

Catherine Morris
The Keystone Center

Denise Mulholland
USEPA Headquarters

Chris Namovicz
DOE-EIA

Andrew Nicholls
PNNL

Philip Patterson
DOE/PAE

David Purcell
DOD-Army

Michael Reed
NETL

Dan Santini
ANL

Hosein Shapouri
USDA

John Shea
New England Governor's Conference

John Sheehan
NREL/SEAC

Michael Shelby
EPA-OTAQ

Walter Short
NREL/SEAC

Mark Sinclair
Clean Energy States Alliance (CESA)

Dave Sire
USDA-USFS

Elaine Sison-Lebrilla
California Energy Commission

Alan Snyder
DOT/RITA/Bureau to Transportation Statistics

Bryce Stokes
USDA-USFS

Denise Swink
Independent Contractor

Diane Turchetta
DOT-FHWA

Bill Valdez
DOE-Office of Science

Maria Vargas
DOE-FE/NETL

Richard Watson
DOI-BLM

Carol White
FERC

Frances Wood
OnLocation

Bill Worek
University of Illinois at Chicago

Appendix 3. Details of Vision Sessions

Criteria for Selection of Vision Recommendations
Five criteria were presented to guide the development of collaborative analysis opportunities:

- On what energy issues/analysis activities do the needs and interests of decision-makers and analysts intersect?
- What energy issues/analysis activities were self-identified as important yet not addressed to a critical mass of participating organizations (i.e. which attracted the most diverse groups of decision-makers and/or analysts)?
- Are current information, tools and models inadequate to address this issue?
- Is there a discrete, actionable activity to address this issue?
- Can a collaborative effort of multiple organizations provide additional value through 1) collaboration on scope (to identify specific activities for different parties to perform), 2) leveraging of resources and capabilities, and 3) sharing of information and results?

I. Electricity

A. Electricity Analysis Collaboration Vision Recommendations

- ***Develop a better understanding /better approach to uncertainty analysis of constraints to energy options.***
    - E.g. how does waste disposal affect the role of nuclear power?
    - How does uncertainty around fossil fuel prices and carbon markets impact the technology choices and cost of electricity?
    - How should we model regulatory uncertainties?
    - How will potential constraints on water supply and use affect current and new technology options?
    - How might uncertainty about transmission capacity and fuel transportation (such as natural gas pipelines and rail transport for coal) affect generation options?

- ***Develop ways to model or reflect the complex and patchwork nature of the regulatory and policy environment and improve the links between policy decisions and technology choices.***
    - Analysis tools are needed to assess how to simulate the complex and sometimes disjointed policy framework, e.g. the disconnect between wholesale and retail restructuring and the state-by-state regulatory environments.
    - Better tracking and forecasting of changes in regulations and policies are needed.
    - Analysis tools are needed to determine how changes in policy will affect the deployment of technologies in the electricity industry, e.g. what are the longer-term impacts of deregulation, how will industry meet accelerate RPS requirements in some states?
    - How much new renewable energy is the result of policies such as standardized interconnection and net metering or how much do standby rates deter renewable energy development?
    - What incentive levels are required to make a project viable?

- ***Improve analysis of transmission system operations and constraints***

- E.g. improve the simulation of contractual transactions flows and constraints which do not always align with physical flows or constraints.
- Improve analysis to help inform decisions about the costs and benefits of generation options that can interconnect with existing transmission versus generation that requires new transmission construction.

- ***Expand analysis to capture the full range of value of electricity alternatives in consistent metrics (apples to apples) to help guide policy that can maximize multiple attributes***.
  - E.g. evaluate alternatives in a way that allows direct comparison of cost, reliability, equity, environmental impacts, contribution to peak or energy demand, economic development impacts.)

B. 2nd Tier Electricity Recommendations

- Improved portfolio analysis tools at the state level to assist with regional planning
- More dynamic analysis to better reflect the impact of renewables on the transmission system.
- Better data on the potential for electricity storage
- Analysis to quantify the financial returns to encourage new investment in transmission and distribution system
- How should we measure or analyze security risks on the electricity system?

II. Transportation

A. Transportation Analysis Collaboration Vision Recommendations

- ***Incorporate behavioral factors in models to better capture how consumers make decisions.*** A suite of tools are available:
  - Penetration models
  - Agent-based modeling where individual or organizations are modeled
  - NEMS approach to modeling manufacturer behavior

- ***Make data collection more complete, transparent, standardized and centralized.***
  - More data on current preferences and use drivers. Participants noted that in some cases, funding for important data collection is being cut (e.g. DOT- National Household Travel Survey and DOT- Vehicle Inventory and Use Survey data gathering).
  - Different tools for collecting data on behavioral factors
  - New data on future technologies is needed in order to support analysis of potential market and environmental impacts. E.g. need to better understand the off-peak electricity requirements of plug-in hybrid vehicles (PHEV).
  - Improved database on biomass resources – current, potential and land requirements
  - Need data on workforce/ skills resource requirement to support implementation analysis

        - Detailed distribution of miles traveled by type of consumer rather than averages

    - ***Develop more comprehensive modeling tools***
        - Making explicit links with models like NEMS
        - Incorporating full supply chain, cross–sector analysis that looks at the impacts between transportation fuels and chemical, fertilizers, and agriculture/food industry.
        - Expanding environmental impacts to include water (e.g. in production of ethanol and tar sands)
        - DOE's EERE is developing a transition model that looks at the competing use of biomass, investor behavior and manufacturer behavior. A possible opportunity for collaboration is between DOE and USDA which is evaluating the efficacy of the 60 billion gallon ethanol target driving the analysis.

B. 2nd Tier Transportation Issues

- ***Develop better ways to account for uncertainty in modeling results.***
    - E.g. NEMS includes multiple cases, but need to understand how to better interpret the probability of those scenarios. Risk analysis and better characterization of risk factors would help.

- ***Greater analysis of infrastructure needs and implications of alternative technologies***

III. Energy Efficiency and Demand Side Generation

A. Key Policy Drivers

- How do we save energy in a hurry and maintain the savings longer?
- Can models be both simple enough to be understood by decision makers and robust enough to be trusted and accurate?
- Can we overcome the failure of models to represent the fundamental dynamics of energy-related decisions?
- What is needed to create and energy efficiency ethic and which approaches are most effective – laws/regulations, market incentives, education, etc.?
- How can we model the vision of expanded distributed generation?

B. Decision Makers

- Government policy makers
- Congressional leaders and staff – different needs and budget considerations
- Technology manufacturers and distributors
- Modelers and analysts
- Energy consumers

C. EE & DG Collaborative Analysis Recommendations

- ***Better understanding of consumers' behavior and non-economic decision factors***
    - There may be empirical data that could help inform analysis about consumer behavior, but analysts are aware of it, therefore, we need better mechanisms to synthesize and share information on how consumers behave.
    - Manufacturer and utility data on consumer behavior could be enlightening; challenge is that it is often treated as proprietary information

- ***Better understanding of supplier decisions; how do new technologies and practices get introduced and how can this be influenced by policy***?
    - E.g. Better understanding of utility decisions, such as how they are planning for carbon caps. May not be as analytically rigorous as we think; regulatory environment plays an important role.
    - Models tend to assume that technologies and services just appear in response to demand without a clear understanding of how entrepreneurs weigh risk, market positioning, etc.
    - Need to understand the critical pathways to achieving successful technology deployment.

- ***Better understanding of programs, policies, and R&D portfolio management and what has worked. Why or why not?***

- ***Better representation the infrastructure needs of new technologies and the new relationships between suppliers and consumers***
    - Should also understand the constraints of existing infrastructure, including human capital infrastructure, and how it needs to evolve.

- ***Better models and linkages between models***.
    - Most macro economic models are designed to show negative economic impacts with any change from Business-as-Usual.because they do not adequately capture the fundamental dynamics of energy-related decisions.
    - E.g. we need better linkages between detailed tools like building simulation models and macro tools like demand analysis models, to analyze system interactions.
    - Need to rely less on over simplified characterization through averages and prototypes and more on probabilistic and agent based modeling that better capture a distribution of responses.

Appendix 4. Details of Outcomes from Breakout Sessions

A. Summary of Breakout Session – Enhance tools and methods for R&D and deployment planning and portfolio analysis.

Session attendees:
List of attendees not collected

Topic clarification:

- How collaboration can improve analytic foundation for planning and portfolio decisions?
- How can we improve the quality of the information for portfolio decisions?
- Portfolio analysis is asking and answering three questions:
    - What has the portfolio done and accomplished?
        - One question we (State agency) always get is "you have R&D projects, what are the benefits to our State?
    - What do we still need to do to achieve our objectives?
    - What gaps do we need to fill to do it?

Important Decision-Makers:

- Utilities
- R&D programs (program managers, team leads, senior management)
    - Folks stressed that upper management relies on expert judgment and the analysis needs to be synthesized
    - Someone commented there is currently a gap in DOE in synthesizing/integrating analysis findings
- States because they manage energy funds
- Regulators
- Consumers
- Manufacturers

Activities Discussion/Brainstorming:

<u>Which comes first – analysis or policy?</u>

1. Analysts provide information to help inform decisions (e.g., how to optimize the portfolio to fulfill stated objectives)
2. Decision makers know what they want to do (often for political reasons) and the analysis is done to support that position

Good analysis is critical to (1) inform decisions and (2) to help inform how best to get where decision makers want to go (i.e. if that is the direction you want to go, here are the realities you should be aware of as you set your goals and timelines). At the end of the day, all analysis has to pass the test of being able to communicate with decision makers in an effective way.

The goal of analysis should be to define the "trade space" within which decision makers have to work and it should not pick winners or losers. Rather, analysis should define the "trade space" and let policy makers decide what to emphasize.

Data needs for portfolio analysis

- Doing a portfolio characterization is important to do before you do a portfolio analysis (enables you to identify common indicators and know your baseline)
- To compare across various programs and evaluate across a portfolio, we need:
    - Consistent set of indicators that can be reported out before we become obsessed with figuring out how we will deal with the differences
    - A common way for all programs to "report out" their information
- Create a clearinghouse of existing information - would be valuable and doesn't exist
- Decision makers at the low and high levels need different information; need tools/results that can be rolled-up to meet the high level needs while still be of value to the low level

Performing portfolio analysis

- There is no core structure for portfolio analysis in energy
    - Organizations seldom look at the whole problem nor do they identifying dependent element of the portfolio (e.g., PV and storage)
    - DOE - Science is considering system dynamic models for basic research tradeoffs
    - System dynamic model is easy to visualize, but difficult to implement – need to be aware of the conditions that need to be in place to accomplish what we want
- We need to find a way to perform portfolio analysis on a consistent basis.
    - Probably is not a single tool, maybe a framework or a suite of tools
    - They needs to be able to:
        - Address potential future scenarios
        - Address the temporal aspects of the portfolio (research vs. deployment)
        - Address risk by considering large uncertainties
    - Integrate/synthesize portfolio analysis work to help inform the portfolio decisions
    - Communicate our findings in terms that decision makers will understand

Collaboration process

- Recommend a multi-year effort, with a step-by-step approach to improving the method and tools, while not holding the near term work hostage to the ultimate tool
- Needs to includes experts on existing portfolio analysis tools; their knowledge is important, we can improve tools and perhaps develop new ones
    - Perhaps EIA could request collecting certain data it doesn't currently collect
- We need to engage more state folks in the input process
- TIMING: Backdate if from June (when the budget reviews take place in DOE) to identify what you need from what players by when to inform the budget formulation process
- One potential solution is to expand Laboratory Working Group effort to broader set of "stakeholders" in a structure way to develop a set of tools along the way

Activities decided by the group:
#1 – Improve framework for analysis

- Risk, value, and uncertainty are three key portfolio analysis areas we need to assess
- Need to identify key areas of portfolio analysis people need input on
    - What can we use that's in place
    - Where are the gaps
    - NREL will be lead for this activity
    - Needs to be independent to have credibility
    - Peer review is critical of Institute's work

#2 – Portfolio analysis center

- Funding is a key issue for all activities
- Science could include request for line-item funding in their August EPAct portfolio recommendations deliverable
- LWG should share their best practices review with the group
- NYSERDA's analysis shop may be a model
- Need to review options for establishing a permanent portfolio analysis capability

#3 – Identify standards of excellence for portfolio analysis – *no discussion because we ran out of time*

B. Summary of Breakout Session – Improve knowledge of lessons, opportunities, and best practices for technology commercialization and deployment partnerships between industry and state/federal government.

Session attendees:

Bobi Garrett (NREL),
Jeff Harris (LBNL),
Audrey Lee (DOE-Policy),
Andrew Nicholls (PNNL),
Mark Sinclair (CESA)
Elaine Sison-Lebrilla (CEC),
Maria Vargas (NETL),

Topic clarification:

- CEC (PIER) research - two of the scoring criteria are availability of partners and benefits to Calif. (but often hard to verify). Need "**Market Transformation R&D**." Tension between near-term time frames and desire for significant MT.
- DOE tends to think of R&D as the answer, rather than a **portfolio** (roadmap) that includes R&D, demonstration, deployment, standards, etc.

Important Decision-Makers:

- Utilities
- R&D programs (program managers, team leads, senior management)
    - Folks stressed that upper management relies on expert judgment and the analysis needs to be synthesized
    - Someone commented there is currently a gap in DOE in synthesizing/integrating analysis findings
- States because they manage energy funds
- Regulators
- Consumers
- Manufacturers

Activities Discussion/Brainstorming:

<u>Data needs for industry-government partnerships</u>

- One key analytical need is better technology characterization, especially distinguishing between production costs and sales prices. Also, need to understand balance-of-system costs (and performance). But cost is not the only constraint.
    - Compile and share information to prevent reinventing the wheel
- Identify Best Practices – get DOE and state program to identify one or more most successful models for (linking R&D and deployment?)
- Identify significant deployment risks; ask states (and utilities, industry, others) to validate that these are the right gaps – and identify what's being done or what's needed.
- Develop a "checklist of deployment mechanisms (policies, programs) to consider" as part of the R&D multi-year planning process. Who-does-what; who are potential partners?

Performing analysis to support industry-government partnerships

- What would it take for a major manufacturer to pick up this technology and really push it, as a strategy for bringing down costs – in other words, better **market analysis.**
- Retrospective evaluation of RD&D solicitation/procurement choices – did we end up with the right partners? If not, how could criteria or processes be improves?

Collaboration process

- Lots of organically-formed "communities of practice" seem to exist (Consortium for Energy Efficiency, State/Regional Working Groups, Wind Powering America, Building America), but often these **do not inform or benefit from R&D** activities or analysis.
    - A specific example is lack of analytical and R&D effort linked to deployment of Integrated Gasification Combined Cycle (IGCC) with CO_2 sequestration.
- DOE-EERE is trying to implement "stage-gate" R&D: make the business case by going to the customer and the market, to get their views. If a market barrier is later discovered, cut off research/pursue another path. Trade-off: prematurely cutting off promising ideas
    - Disconnect: "stage-gate" R&D and the Government Performance and Results Act (GPRA)[1] process, which assumes complete technical success and projects.
- At both the state and federal level, it has been very difficult to engage the financial community in any partnerships/collaboration.
- Perhaps DOE can form their own venture capital firm (Ray Orbach's proposal)
- Laboratory Working Group was formed to link basic and applied research; maybe reconstitute that (or a parallel group) to address research/deployment links.

Activities decided by the group:

Activity #1 – Evaluation

- what? Evaluate successful (icon) program models for collaboration that links R&D and Deployment – state and DOE, including Lab tech-transfer and STAC/ASERTTI
- who? CESA (lead?), CEC, DOE/PI, PNNL, NREL (lead?), NETL
- how? Scoping paper (brief inventory of programs, issues, approaches), then discussion by committee, then consider workshop

Activity #2 – Analysis methods and tools

- what? Share examples and Best Practices in Technology Characterizations (including GPRA) and Market Assessments. Develop checklist on deployment methods (barriers) and decision tools for use in R&D multiyear planning.
- who? NREL, EPRI, CEC, NETL, CESA
- how? Draw on best-practices from #1 to develop checklist(s); EERE could offer to pilot-test the checklist(s) in its own budget process (PAE could tie this into guidelines for multi-year plans). Note: Checklist of deployment paths to consider should include govt's own policy mechanisms: standards, tax incentives, voluntary programs, etc. Need to cross-link this idea with the Portfolio Planning breakout group.

[1] GPRA was created in 1993 to decrease waste and inefficiency in federal program; it requires that all federal programs set clearly defined goals and identify each program's performance and results, which is then reported to Congress to help with decision-making.

Activity #3 – Policy Mechanisms

- what? DOE invitation to states to participate in front-end of RD&D planning (pay travel and time), and to send appropriate staff to participate in state RD&D planning. Support demo projects on deployment by DOE and states. [?? What's new here? Is this part of today's analysis topic?]
- who? CEC, CESA, NREL (invite NASEO, ASERTTI)
- how?

Activity #4 – Communications

- what? Get feedback from intended users of info – does the info make sense to them? Accessible? Consistent (etc.)? Narrow the scope, to start (by audience preferably, not by energy topic). How much effort/$ spent to create this information; is there avoidable duplication of effort?
- Develop common definitions (of zero-energy bldgs; others??)
- who? (in definitions task),
- how? Surveys, interviews, focus groups. Explore Website and Hotline usage data. Look at where there is a need for clearer definitions and terminology (Zero Energy, Demand Response)

C. Summary of Breakout Session – Improve representation of energy technologies and demand response in energy models, including the next version of NEMS.

Session attendees:

David Chien (DOT),
Karlynn Cory (NREL),
Steve Dunn (EPA),
Allen Fawcett (EPA),
Jeff Harris (LBNL),
Susan Holte (DOE-EIA),
Michael Leifman (DOE-EERE),
Chris Namovicz (DOE-EIA),
Andrew Nicholls (PNNL),
Phil Patterson (DOE-EERE)
Walter Short (NREL),
Alan Snyder (DOT),
Maria Vargas (NETL),
Carol White (FERC),
Frances Wood (OnLocation)

Topic clarification:

- Which models? All models – including NEMS
- There are a lot of needs to improve these models

Important Decision-Makers:

- Federal government decision-makers (what benefits from federal programs?)
- State public utility commissions (costs and benefits from technologies, programs, real-time pricing)
- Manufacturers
- Utilities (as buyers, demand side management funders)
- Legislators (fed and state)
- Policy-makers on climate change policies
- Regional energy planning organizations
- Program managers (federal, state, utilities)
- Industry and trade groups

Activities Discussion/Brainstorming:

<u>Data needs for improving technology and demand response in energy models</u>

- Policy makers may not be asking the questions to which they really want the answers – just those they think they want answered (not necessarily the same, or complete)
- Different decision-makers have different information needs (what is important to whom?)
- Many times the front-end assumptions directly impact the range of potential outcomes; can this impact be quantified so modelers focus on improving the most important ones?
- Very little recent work on price elasticities; this impacts all of these models substantially
    - Most work done in the late 1970's (except Goldman et al (demand response, or DR); some CA pilots)
    - David Greene (ORNL) has been keeping up transport sector elasticity studies
    - For DR – need more work on how enabling technologies impact elasticities
        - E.g. smart meters, smart thermostats, wireless/web-based controls

- Technology change over time
    - Technology learning, economies of scale; (separate from R&D)
    - Learning in technology cost (from first version to commercialization)
    - What were the market dynamics and actors? (e.g. steel prices, fossil prices)
    - How might things have been done differently, in retrospect – especially for policy interventions – and how does this inform future policy? (include some faster and some slower penetrating technologies)

<u>Performing energy modeling and other analysis</u>

- Better modeling of trade-offs between technologies and the subsequent impacts on price
- Better "what-if" modeling is needed, to help consider policy questions
    - EERE VISION model for transportation is pretty good at this
- Scenario analysis – how can I achieve a specific goal, no matter what market will do?
- What is the potential for a new, emerging technology? (Market share, impact if adapted)
- Are energy efficiency (EE), DR, and renewable energy (RE) truly modeled accurately in models? At what point should they be introduced.
- Currently, DOE-EERE does a lot of work on Technology Characterizations of energy efficiency and renewables; NETL has characteristics of fossil technologies.
- We need to better quantify the impact of adding/removing budget from a program
- Buildings need better envelope modeling and cumulative impact of several applications
- David Greene (ORNL) has been keeping up transport sector elasticity studies; what about other sectors?
- Most models are usually weak at incorporating economic feedbacks (usually exogenous)
    - Better interconnection of sectors and their impact on economics and economy
- Models don't deal well with transients
    - Demand-management, demand-response, and grid reliability value.
    - Demand-side aspects of systems with min. slack and redundancy (gas deliveries).
    - Demand-side in short-term models (underlying assumption that demand is inelastic in the short-term; so EE takes time to influence).
- Look more at consumer response to rate structure, not just rate levels
- How have first-costs of specific technologies changed over ~20 years, historically. Can this information be used to inform future modeling?

<u>Collaboration process</u>

- Stanford Modeling Forum has been active.
- There is a need for collaboration to identify cross-market impacts
    - Technologies introduced in one sector may impact other sectors (e.g. fuel cells)
    - Advances (or failures) in one market segment may affect progress in another.
- Increase transparency and user-friendliness: need models that decision-makers and their staff can play with and understand, trust
- Modelers need to better identify what matters to decision-makers
    - Which factors give decision-makers the greatest leverage and what are the potential impacts of taking action on them?
    - How to reduce fossil fuel use at the lowest cost?

- Look across state/regions (or even across sectors?) at "natural experiments" from which we can gain useful insights – for modeling and for policy/program decisions
- EPA is having a forum next month on reflecting technology changes in modeling (Pete Wilcox, Alan Sanstad, others...)

Activities decided by the group:

1) Technology cost and performance evolution – Improve understanding, from looking historically at actual (EE and RE?) examples, past rates of technology change (cost, performance) and the underlying dynamics and drivers, at the emergent, pre-commercial, and fully commercial stages. Incorporate these empirical findings into technology maturity and saturation curves in models. Also impact of global markets.

2) Potential for new/emerging technologies (EE and RE only?)
- need careful terminology; people can mean very different things (risk, time-frame) when referring to energy technologies
- by definition, since it's "new/emerging" there's uncertainty in characterizing cost and performance, how these will evolve, or what market prospects are
- also need to consider substitutes and competitors
- need some good horizon-scanning (including outside the US)

3) New empirical work on elasticities
- Distinguish short-term and long-term elasticities
- For DR, need more work on how enabling technologies affect elasticities
- (e.g., smart meters, smart thermostats, wireless Web-enabled controls)
- This illustrates the point that an elasticity is an observation, not an explanation!

- <u>For each of the above</u>: the first priority is improved data, not improved specification in the model. (but need to consider from the start how the model will use new data)
- Most work on improving technology characterization in models has been done outside the US (for climate/mitigation modeling); Stanford Modeling Forum has also been active.
- For collaboration potential, ask two questions:
    - Who else does modeling (e.g., some states, for elec., US and intl groups for climate change)
    - Who is a current (or potential) source of technology data (not necessarily for modeling purposes – could be others)

D. Summary of Breakout Session – Improve models to better represent regional technology characterizations; improve transmission constraint representation.

Session attendees:

Karlynn Cory (NREL),
Michael Leifman (DOE-EERE),
Lynn McLarty (TMS),
Chris Namovicz (DOE-EIA),
Phil Patterson (DOE-EERE),
Michael Reed (NETL),
Walter Short (NREL),
Richard Watson (BLM),
Carol White (FERC)

Topic clarification:

- For both topics, there are three main questions
    1. What level of regional detail is appropriate for national models?
    2. What tools/analyses are available/required to answer regional questions?
    3. What is the cost/benefit tradeoff of regional detail?
        - Model development costs,
        - Operational complexity,
        - Interpretation/uncertainty of results
- Need to separate out regionality from transmission constraints – both large topics

Important Decision-Makers:

- State government, including Governors and legislatures
- Organizations that influence Regional Transmission Organization activities
- Utilities
- Generation developers
- Industry and trade groups

Activities Discussion/Brainstorming:

(A) Regional Technology Characterizations in Energy Models

<u>Data needs for improving regional technology characterizations in energy models</u>

- Resource quality – regional and local
- Water supply
- Emission constraints – differs by region (sometimes city)
- Better identification of siting opportunities and constraints
    - Regional and local acceptance
    - Population density and land availability
    - Infrastructure – societal, political, regulatory and incentives
- Constraints associated with energy/fuel transportation (e.g. coal)
- More accurate demand/load profiles, that includes temporal resolution
    - Right now, population growth is a baseline input, not a feedback into the model

Performing energy modeling of regional technology characterizations

- Renewables have a heterogeneous resource supply (quality) and dispersion (location)
- Characterization of existing and evolving generation mix; how this impacts the regional energy value (regions with lots of coal are cheaper than if mostly natural gas)
- What level of regionality do you need in a national model (false precision?)
- What level of investment yields the specificity desired?
- To what degree do national models need to include regionality?

Collaboration process – regional characterizations

- Better data you have going in, better outputs – let's develop better data/inputs
- Issue: lots of government work is contracted out using proprietary models and much is held in the private sector, or at RTOs; How to do effective collaboration?

(B) Transmission Constraints in Energy Models

Data needs for improving transmission constraint representation in energy models

- Accurate information and inclusion of all transmission options
    - Costs and losses associated with transmission expansion
    - Accurate representation of pancaking; intra- and inter-region energy trading
    - Model reactive losses
    - Demand-side management
    - Storage
    - Plug-in hybrids (perhaps modeled as a resource, not just a drain)
- Better capture of geographical relationships between demand center, generation locations, resource locations and grid operations

Performing energy modeling of transmission constraints

- Access to existing transmission (contractual vs. actually available; time dependency)
- Siting and cost of expanding transmission; RE limited by locality and natural gas is very flexible
- What is the impact on grid of additional non-dispatchable, variable technologies
- Need better representation of regional flow in models
- Need to include all transmission alternatives in models: generation, storage, demand side management as well
- NEMS doesn't see congestion; a better understanding could address those needs in the model and can highlight options for decision-makers.

Collaboration process – transmission constraints

- Restructured areas without Integrated Resource Planning need particular help in thinking about the trade-offs between transmission, generation and other options. RTOs may be watching, but they don't have any authority to require action
- Modeling transmission is complicated; often large transfers between regions.
- Issues with increased representation of transmission constraints
    - The more granular you get, harder to see what you've got
    - Each new variable adds complexity, cost and run time.
- Coordinate disaster planning by coordinating analysis of potential disasters.

Activities decided by the group:

1. <u>Inventory existing capabilities</u>
   - Identify and inventory of existing regional models - determine what tools are available now that are required for regional questions? REMAP (renewable energy modeling analysis partnership) effort – try to assess what is available out there - NETL, NREL, states, CESA
   - Inventory capabilities of tools/capabilities, strengths, capabilities of analysis organizations – PAE, NREL, etc.
     - Look at what the Lab Working Group to identify a starting place for DOE.
     - Determine what EPA is doing to improved MARKAL on a regional level – PAE
       - Link MARKAL with the REMI (local detailed economic model) – for RGGI states? "Economic geography model"
       - Supporting (data) to the RGGI states – using MARKAL to do analysis
       - Effort in research triangle park to link environmental pollutant work through a MARKAL model on a regional basis
     - GEMSET as a model; to utilize it as a tool – NETL is willing to lead.
     - GIS tool – dedicated core group of people; emergency services, disaster planning. If a hurricane does this much damage, what are the energy impacts on that area – create maps and see geography, overlay pipeline, etc. can characterize what is, but can do geographic analysis of where the wind areas are, transmission is, etc. – NETL
2. <u>Share existing data, if possible</u>
   - Find a means by which we can share our GIS databases (although some are proprietary); might not be able to do this, unless multiple entities purchase it together (change contract process). Perhaps they could purchase together. Darrell would like to use GIS for target customers.
3. <u>Examine regionality and transmission improvements in existing models</u>
   - NREL and NETL will examine value of incorporating regionality into SEDS for purpose of sensitivity analyses. Additional effort: There could be a collaboration to look at regionality to SEDS – goal to have it turn around in 10 minutes and not 3 days. Do a sensitivity analysis to see what level of regionality makes sense.
   - Investigate whether NEMS should represent NERC regions or RTOs. EIA – electricity regions; considering using NERC based regions or RTO regions? What data changes would you need to make to do this in NEMS? Is it worth going from an NERC region to an RTO region – DOE/EIA, NREL, NETL, FERC
   - Use of existing transmission lines – how best to capture that in these models. NREL
4. <u>Calibrate between models</u>
   - Sensitivity analyses within a model and across models. EX SEDS – Michael Reed is getting trained on Analytica to learn how to do SEDS (one region model). He will take on an exploration of sensitivity – which variables does it make sense to put uncertainty ranges around? REMAP effort with respect to RPS. NETL

E. Summary of Breakout Session – Improve impact evaluation tools and best practices to quantify benefits: (a) economic development, (b) energy security, (c) environmental impacts, including integration of all three.

Attendees

Brian Card (DOE-EERE)
Charles Drummond (NETL);
Stephen Dunn (EPA)
Skip Laitner (ACEEE);
Dan Loughlin (EPA);
Denise Mulholland (EPA);
Catherine Morris (Keystone)
David Shen (TMS);
Dave Sire (USDA);

Topic clarification:

- Evaluation impact includes prospective and retrospective back. Focus currently is on prospective
- Need to address risk of achieving technical goals
- Need analytical efforts, models, tools that look at resources (from fossil to efficiency) that looks at interaction.

Important Decision-Makers

- States – governors, agency heads, legislators
- DOE – Secretary – funding & program;
- Office of Management and Budget & Congress;
- EPA
- ACEEE – state & industry leaders (for example DOW 25% reduction by 2015 in energy intensity goal)
- Consumers in a limited fashion

Activities Discussion/Brainstorming:

<u>Data needs to improve evaluation tools</u>

- Need to know what is out there – Create a thorough inventory of existing models, explaining model outputs and methodology differences. Identify best practices.
  - Michael Leifman's renewable energy modeling workshop exercise a good approach
  - Update 1990 DOE document (Sec. Watkins) addressing the current state of modeling – under office of Policy? (Skip Laitner said he would provide correct citation).
- Consistent data in multiple models. How to link two models, or insure appropriate transfer of data (e.g. link MARKAL with REMI model to share assumptions).

<u>Performing benefits analysis</u>

- Economic parameters and their relationships are not modeled properly – can often yield negative results to a new policy in modeling tools.

- One example is price signal from a carbon charge – prices goes up; can only have negative impact on GDP; anyway – should model any case that leads to negative GDP.
- Another example: NEMS uses global insight feedback model which looks at increase in consumer product as inflationary.
- Another example: combined heat and power is being put into building through a third party – where the incentive is energy savings percentage, not initial costs.

- Models cannot deal with wide variation of fossil prices we are currently experiencing and should be revised to be able to deal with the 1) high prices 2) wide variation/fluctuation.
- Calibrate forecasting method with historical data. EX NEMS should look back at previous forecasts with current data to see variance and adjust projection accordingly. Quantities were about right, but the energy prices were wrong.

Collaboration process

- Need to validate models using organizations outside of the model operator; great opportunity to collaborate
- Dis-aggregation of input & output data to state level to see the national impact as well as impact of national policy on a state/region
- Develop consistent method and tools for dealing with technology optimism. Looking at the same types of risk across different technologies.
  - Suggestion of looking at GWU site using Delphi approach – is there a way to integrate a Delphi approach with time series data?
- **Full account of all impacts** – most models only cover investment cost, energy savings
  - Four categories of costs (R&D, program, investment/labor to get installed, & transaction costs – like training) &
  - Four categories of benefits (energy savings, non-energy savings like productivity gains; health/environmental benefits and less need for control technologies; and spill over beyond original targeted area like DG coming from jets).
- Collaborate on model development. Example AMIGA model looks at petroleum refiner information – this portion could be used by EIA in NEMS.

Activities decided by the group:

ACTIVITY	**DATA TOOLS**	**PARTICIPATING ORGANIZATIONS**
(1) Full Accounting of Impacts – assume ACEEE/NREL lead	White Paper, workshop	ACEEE, NREL, Univ of CA, EPA, DOT, DOE, Ag, FERC, RTOs, HUD, PMAs,
Next steps – Identify potential participants/sponsors, event in fall/winter 2006, collective websites (wikipedia)		

(2) Appropriate specification of relationship between economic factors (econometric data.)	NEMS, EMF models, MARKAL-REMI,	same
Next steps – 1. assessment of critical factors; 2. Key relationship of ?; 3. Model		

inventory; 4 Best practices workshop.

(3) Validation of results of evaluations tools	White paper on validation method	Same with additional modelers/users as appropriate
Next steps – succeeds model inventory; Develop appropriate Validation method for each model; Id the models that need validation; develop white paper on validation methods; conduct validation exercise		

(4) Model inventory & best practices and identify strengths/limitations		

F. DEVELOP IMPROVED POLICY ANALYSIS TOOLS AT THE STATE AND NATIONAL LEVELS, INCLUDING SCENARIO ANLAYSIS TOOLS; IDENTIFY WAYS TO LINK/INTEGRATE POLICY ANALYSIS TOOLS AT THE STATE AND NATIONAL LEVELS.

Session attendees:
List of attendees not collected

Topic clarification:

- Lots of tools and information are available, but usually at the federal level
- Applicability to states is unclear and often cannot be determined (e.g. NEMS)
- Is there a way for national models to be useful for states? Or can you only depend on regional analysis tools?
- Scenario analysis is very important; non-expert users need to understand how to perform

Important Decision-Makers:

- State policy-makers, including public utility commissions, legislatures
- Federal policy-makers
- Regional Transmission Organizations

Activities Discussion/Brainstorming:

<u>Data needs to improve policy analysis</u>

- Need central information source on technology supply curves and fuel information
- Need information on what the decision-makers consider important to influence the structure and outputs of models
- Too much information for decision-makers can be confusing
- Sometimes politics is more important than the analysis – renewable portfolio standards (RPS) are often created before technical or system impacts analysis is performed.
- NEMS is often used as source of technology characterization, but it doesn't capture regional characteristics well.
- Most commonly used models for policy analysis
    - NEMS
    - MARKAL national
    - Altos Management-1
    - IPM (electricity sector only)
    - VISION (DOE transportation)
    - AMIGA
    - USEPA exploratory modeling – what drivers lead to what outcomes
    - RPA – FS/USDA
    - Forest inventory – state foresters
    - HYTRANS – ORNL – national model on hydrogen in vehicles
    - ADAGE

Performing policy analysis

- Most states do not have in-house modeling capabilities; regional entities have more
    - Need user-friendly models that non-experts can use and understand outputs
    - Guidance on applicability of national models for states/regions would be helpful
    - Regional modeling is often needed because it is more applicable to the state
    - Input-output models are OK if the state user can understand the assumptions, methodology and outputs.
    - There are resources available: DOE Technical Assistance Program and EPA Clean Energy-Environment Program; free assistance for states
- Additional policy analysis tools should be developed
    - Consider all future possibilities – see which technologies win under what circumstances (e.g. hydrogen)
    - Characterize product flows
    - Scenario analysis/relationships of variables are more important than forecasts
- Need to test variations and sensitivity – probably using the same tools
    - Best to have 3 scenarios that are easy to understand for decision-makers, that is ideally backed by stochastic model that incorporates uncertainty
    - Can also test different types of policies
- Need better validation between retrospective and prospective analysis, so they converge

Collaboration process

- There are some existing collaborations on policy that may have lessons learned:
    - NYSERDA uses GE MAPS to look at impact on existing generation plants of meeting RPS targets over 20 year period
    - RGGI model (northeast carbon market analysis) is being managed by ICF (IMPLAN)
    - EIA has helped NY state with modeling runs.
    - EPA Research Triangle Institute using ADAGE model (based on IMPLAN) and is trying to link this with integrated planning model
    - EPA and NESCAUM (Northeast States for Coordinated Air Use Management) working to link MARKAL and air quality models (SMOKE and C-MAT) in New England and eventually the RGGI region (includes transport, power, commercial, industrial and residential)
    - Stanford modeling forum
    - DOE-EPA modeling forum
- Need better links between energy and environment modeling (even EE and RE modeling)
    - No modeling at the state level; federal guidance would be very helpful
    - NY can look at incentives and compare against purchase of EE technologies
- Is there a way to link or integration state and national policy tools?
    - A lot of work in UC Davis and national labs to develop models from very narrow to national models. DOE-PAE sponsored.

Activities decided by the group:

Activity #1 – Identify and Advertise Existing Information, Tools and Resources

- Identify existing information, tools and resources available (e.g. DOE Technical Assistance Program, EPA Clean Energy/Environment Program, etc.)

- Phone survey to understand decision-maker needs better
- Develop better technology-specific information to understand impact on big picture
- Share the information and tools on a website
- Perhaps put together an e-mail listserv for communication
- Lead: DOE-PAE and NREL
- Participants: ?? Include environmentalists and industrials

Activity #2 – Improve Policy Analysis Modeling

- Learn lessons from existing forums
    - Stanford energy modeling forum
    - DOE-EPA Renewable Energy Modeling Forum
- Develop guidance on how to structure models (i.e. develop common methodology)
- Especially for those without modeling capabilities, provide a clear and concise interpretation of applicability (by technology and region) and results at the decision-maker level, for each model and the results of any particular run, or set of scenarios
- Specific needs:
    - A comparison of technology supply curves; how different are they?
    - Scenario analysis – at least 3 scenarios, if not stochastic
- NYSERDA assesses national and state-side energy markets and informs stakeholders – other might be able to learn from their feedback process.
- DOE and EPA can help fund travel of state agencies with limited budgets
- Lead: DOE-PAE and EPA?
- Participants: ??

Activity #3 – Attempt to Integrate State and Federal Policy Analysis

- Strengthen national/state policy analysis personnel connection
    - Consolidation of DOE regional offices has created a gap
    - Federal offices need to remember to interface with states
- Identify/create regional models that speak to state issues
    - Linking models together is necessary to help states but difficult
    - This forum reinforces the significance of EPA's efforts to integrate models together
- Lead: EPA? and DOE?
- Participants: ??

G. ENHANCE ANALYSIS OF AND TOOLS FOR TRANSPORTATION FUEL RESOURCE POTENTIAL AND INFRASTRUCTURE; INITIAL TOPIC IS BIOFUELS.

Session attendees:

Kara Colton, National Governors Assoc.
Ed Coe, EPA-OTAQ
Rob Fireovid, USDA-Ag Research
Rich Halvey, Western Governors Assoc.
Thomas Jenkin, NREL
Audrey Lee, DOE-Policy
John Maples, DOE-EIA
Lynn McLarty, TMS
Michael Reed, NETL
Dan Santini, ANL-Transport Center
Hosein Shapouri, USDA-OCEcon
John Sheehan, NREL

Topic clarification:

After much discussion and debate, the decision was made to examine biofuels in transportation in the broadest context possible, to emphasize looking at the entire transportation system.

How do increase energy independence and energy security in the U.S. transportation sector

- *sustainably?*
- *environmentally?*
- *reliably?*
- *economically?*

There are three sub-questions of interest to decision-makers:

1. What is the universe of potential solutions for transportation, and how are they related *(thinking about rewards and trade-offs)*
    a. Current status
    b. Technical and resource potential
    c. Environmental economic and sustainability issues
2. What transition scenarios/pathways are available? (*understand the who, how and when)*
    a. What can we do by when at what cost?
    b. What is the most effective balance of public and private sector actions?
3. How do we instill common and consistent practices across different organizations in preparing and reporting analytic results (life cycle, techno-economic analyses, etc.) *(trust the analysis and its results)*

Important Decision-Makers

- Included individuals at the national, regional, state and local level—up to, and including, the individual consumer.
- Administrators and agency leads in Federal departments (eg, USDA, DOE, EPA, DOT, DOI)
- White House Office of Management and Budget
- National, state, regional and local elected officials (including members of Congress, governors, state legislators)
- Industry (including automakers, energy companies, forest products industry)
- Farmers
- Consumers

- Shipping/transportation industry (trucking, rail, barge, pipelines)

Activities Discussion/Brainstorming:

<u>Data needs to improve biofuels analysis</u>

- Land/resource availability for biomass
- Reliability of biomass supply
- Type, quantity and quality of biomass raw materials
- Total potential supply and cost of biomass (i.e. supply curves)

<u>Performing biofuels analysis</u>

- Incorporate environmental and economic impacts of biomass through life cycle sustainability impacts
- Identify infrastructure needs at various steps along the supply chain
    - Biomass collection and distribution
    - Biofuels distribution (pipelines, fueling stations)
    - Vehicle capability
- Optimizing the range of possible fuel products from biomass
- Transition and establishment of new biofuels supply chain
    - Balance between private and public sector roles
    - What is the most effective way to bring about the desired change we seek
- The role (and integration) of biofuels in the broader portfolio of transportation solutions on both the supply and the demand side. (Multi-pathway studies for transportation)

<u>Collaboration process</u>

- Use Argonne's existing transportation system life cycle model (GREET) for evaluating different vehicle and fuel technology options
- Explore use of USDA's FASOM model to identify land use issues associated with food vs. fuel competition; how farmers make decisions between the two; how risk and government subsidies play into their decision
- Expand capability of EIA's biomass modeling; emphasize biomass supply curves in NEMS
- NETL can provide fossil-based options to include in the analysis of different scenarios and transition (e.g. gasification and goals to liquids; sometimes geographical)
- Use of NREL's Biomass model to address transition and further consider limitations of real models through the use of finance
- Create a collaborative group that includes decision-makers to decide what is most important in near term; understand what exists and allocate resources between investment and resources
- Work with decision-makers to understand how thy view policies and the transition away from petroleum so that it translates to real results in real life

Activities decided by the group:

Activity #1

Immediate Need	Consistent, vetted biomass supply curves
Action	Meeting to coordinate multiple efforts already underway to establish regional biomass supply curves.
Lead	John Sheehan (temporary)
Participants	USDA Office of Energy, USDOE EERE Office of the Biomass Program, Energy Information Administration, USDOE EERE Planning, Budget and Analysis, USDA Forest Service, USDA Agricultural Research Service
Timing	July 2006

Activity #2

Immediate Need	Explore DOE's prototype transition model for biomass as an avenue for developing strategies and timing of deployment
Action	Meeting describe prototype model for modeling farmer and investment behavior in investing in a new biofuels supply chain. Look for ways to improve our modeling of transition scenarios and new sources of data. In particular, USDA has identified new work needed to model farmer behavior/decision-making (see menu of opportunities for collaboration.
Lead	John Sheehan (temporary)
Participants	USDA Office of Energy, USDOE EERE Office of the Biomass Program, Energy Information Administration, USDOE EERE Planning, Budget and Analysis, USDA Forest Service, USDA Agricultural Research Service. Expand this discussion to include NETL and state organizations.
Timing	July 2006

H. IMPROVE ANALYSIS OF BEHAVIORAL FACTORS IN MARKET/CHOICE MODELS AND TOOLS.

Session attendees:

Doug Arent (NREL),
Brian Card (DOE-EERE),
David Chien (DOT-BTS),
Ed Coe (EPA-OTAQ),
Susan Holte (DOE-EIA),
Jordan Kislear (DOE-FE),
John Maples (DOE-EIA)
David Purcell (DOE-HQDA)
Dan Santini (ANL),
Bill Valdez (DOE-OSc.)

Topic clarification:

- Improve behavioral factors in models to better understand how to commercialize new knowledge/technology/innovation
- Different actors across the value chain – therefore different motivating behavior factors
- Consumer behavior in residential and commercial market even less understood than behavior in vehicle market

<u>Data needs to improve behavioral factor analysis</u>

- Issue: consumer behavior is often anecdotal and uncertain
- Many things that influence behavior are not represented in modeling:
    - Safety
    - Purpose of purchase (e.g. low-cost, high-mileage car used solely for commuting)
        - Current coefficients based on "one consumer;" perhaps it would be better to capture "multiple consumers?"
    - Socioeconomic impact of income (somewhat captured in size choice, but for the most part, it is not accounted for)
    - Financial incentives provided by manufacturers
    - Importance of brand (e.g. new Coke); attempts to capture this phenomenon, but not in current models
    - Policy impacts (CAFE standards impacts manufacturers decisions on domestic production; interior based – cars or based on truck footprint)
    - Manufacturer
        - Behavior beyond consumer behavior and policy;
        - Economic health and position in market
    - Environmental/green factor
    - Non-financial incentives (e.g. high occupancy vehicle lane for hybrid cars)
- Data exists in consumer appliance field, but is not shared

<u>Performing behavioral factor analysis</u>

- A lot of work done on vehicle choice models – particularly by the Big 3 automakers; they have purchased or produced a lot of commercial marketing info
- NEMS: 3 classes of consumers, based on previous equipment owned
- DOE-Science interested in model that allows them to see hand off point – where an idea gets to a point that it can be made into technology/product
- Modeling difficulty: preference changes over time (assumptions usually static). Example: who would have assumed that we would be driving such large cars now?

- DOE-Science conducting an OSTP workshop on how to understand factors between science and technology. Looking at "black box of knowledge creation" and what occurs using surveys, patent & paper analysis, network theory. Survey done for what exists; shows not much available directly addressing this.
- DOE-Science is also looking at the value of knowledge (utility is perceived by market; what factors allow market to adopt this knowledge). Completed one study on applied mathematics. 2nd study on nanocenters to get to value proposition and knowledge.

Collaboration process

- There is a multiple agency effort to use the FERAM model on vehicle choices and decisions (DOT/EPA/DOE).
- Should we reform current models or look for more revolutionary approach? Believe that structurally the models are sound, but could use substantial improvements. Believe that transportation better than electrical.
- Models not good in capturing application of technology (example of hybrid as an efficiency application or a performance application). Another example was highly efficient windows leading to much more window space in construction.
- Lots of data needs; and the need to incorporate the information into the models

Activities decided by the group:

Activity #1 – Document Federal Government Behavioral Factor Data and Models

- Goals: Identify existing data and models on behavioral factors
- Current related activities: (1) Several models are used by DOE, EPA, DOT; (2) EIA actively monitors data availability (is cutting back on surveys; some entities will not sell data to EIA because they will lose customers; others allow data sharing – EIA piggybacks on ORNL vehicle data purchase from P.R. Polk (?)); DOE-EIA funded ANL survey look at CENSUS (clearance issues due to freight sector); and() activity at the state level?
- Next Steps: (1) Set up a meeting to discuss next steps; (2) Through survey (or other means) collect information about existing data and models; (3) Compare how different agencies use the information and perform analysis (methodology); (4) Identify best practices to improve modeling of behavioral factors (including incorporation of data into models; consider cost/benefit and appropriateness); and (5) identify other options for getting data – including using universities for surveys, behavioral research or collaboration with private sector (associations, companies)
- Lead: DOE-Science and DOE-EERE
- Participants: EPA, DOT

Activity #2 – Convene a Behavioral Specialists Workshop

- Goals: Bring together experts in the field; discuss data/ tools and how to improve them
- Current related activities: (1) NSF asked for $7 million to do behavioral modeling (07 budget). (2) David Bornstadt doing some work for DOE-EERE-PAE; (3) Defense labs are doing some agent-based work that might be helpful; and (4) Activity #1 – get picture of current data and models in order to know how to structure the workshop

- Next Steps: (1) Work through OSTP process to help direct NSF's funding; (2) Hold a meeting to begin planning the workshop, or perhaps a seminar series on consumer behavioral economics and behavioral factors.
- Lead: DOE-Science, OSTP, NREL
- Participants: DOT, DOE-EIA, DOE-EERE, DOD, EPA, National labs

Appendix 5. Acronyms and Abbreviations

ABA	American Bar Association, a voluntary professional law association that has a Renewable Energy Resources Committee and runs periodic webcast forums
ACEEE	American Council for an Energy Efficient Economy
ADAGE	Applied Dynamic Analysis of the Global Economy, a dynamic computable general equilibrium (CGE) model capable of investigating economic policies at the international, national, U.S. regional, and U.S. state levels.
AESP	Association of Energy Services Professionals
AMIGA	All Modular Industry Growth Assessment, a general equilibrium modeling system of the U.S. economy that looks at multiple sectors, using explicit technology representation in the electric sector, transportation, macroeconomics and economic growth.
ANL	Argonne National Laboratory
ASERTTI	Association of State Energy Research and Technology Transfer Institutions
CAFE	corporate average fuel economy (CAFE) standards
CEC	California Energy Commission
CEC-PIER	CEC's Public Interest Energy Research
CESA	Clean Energy States Alliance, an organization that coordinates between states with system benefits charge funds designed to support clean energy technologies
CMAQ	Community Multiscale Air Quality – an EPA air quality model designed to evaluate air quality management practices for multiple pollutants at multiple scales that includes chemical and physical interactions in the atmosphere
DOD	U.S. Department of Defense
DOE	U.S. Department of Energy
DOE-EERE	DOE's Office of Energy Efficiency and Renewable Energy
DOE-EIA	DOE's Energy Information Administration
DOE-FE	DOE's Fossil Energy Office
DOE-OE	DOE's Office of Electricity Delivery & Energy Reliability
DOE-OSc.	DOE's Office of Science
DOI	U.S. Department of the Interior
DOI-BLM	DOI's Bureau of Land Management
DOT	U.S. Department of Transportation
DOT-FHWA	DOT's Federal Highway Administration
DOT-PO	DOT's Policy Office

DOT-RITA	DOT's Research and Innovative Technology Administration
DR	demand response
EE	energy efficiency
EO	energy office (usually a state energy office)
EPA	U.S. Environmental Protection Agency
EPA-OAP	EPA's Office of Atmospheric Programs
EPA-OTAQ	EPA's Office of Transportation and Air Quality
EPRI	Electric Power Research Institute
FASOM	The Forest and Agricultural Sector Optimization Model (FASOM) is a dynamic, nonlinear programming model of the forest and agricultural sectors in the U.S. designed and operated by USDA
FERC	Federal Energy Regulatory Commission
GE-MAPS	Multi Area Production Simulation Software, an hourly production model of the U.S. electrical system developed by GE
GEMSET	Government Energy Market Segment Evaluation Tool, a model that projects the future cost of electricity and environmental outputs in the electricity sector, developed by NETL
GIS	Geographic Information Systems, a computer language that can capture, store, analyze, and display data using geographic references (i.e. by location)
GPRA	Government Performance and Results Act was enacted in 1993 to focus federal government programs on the results of activities undertaken. Under the Act, agencies are to develop multiyear strategic plans, annual performance plans, and annual performance reports.
GREET	Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation model designed to evaluate the energy and emission impacts of advanced vehicle technologies and new transportation fuels, developed by ANL
GWU	George Washington University
HUD	U.S. Department of Housing and Urban Development
HYTRANS	A hydrogen transportation model designed to model the transition to a hydrogen vehicle system by determining a market equilibrium solution, by maximizing consumption minus production, distribution and other costs, developed by ORNL
ID	identify
IGCC	Integrated Gasification Combined Cycle
IMPLAN	An economic impact modeling system for states, counties or multi-county regions
IPM	Integrated Planning Model, a linear programming optimization model of the electric power and boiler sectors that produces generation, capacity, price and emissions forecasts, developed by ICF Consulting.

IEEE	Institute of Electrical and Electronics Engineers
LBNL	Lawrence Berkeley National Laboratory, a federal laboratory of the Department of Energy
LWG	DOE's laboratory working group, a collaboration between DOE national laboratories
MARKAL	A long-term optimization model that includes a variety of energy technologies and allows for evaluation of alternative technology and policy options, developed by the International Energy Agency's Energy Technology System Analysis Program
NARUC	National Association of Regulatory Utility Commissioners
NASEO	National Association of State Energy Officials
NCSL	National Conference of State Legislatures
NEMS	National Energy Modeling System, a large energy model developed and operated by DOE-EIA
NERC	North American Electric Reliability Council, who is charged with ensuring that the bulk electric system in North America is reliable, adequate and secure.
NETL	The National Energy Technology Laboratory, a federal laboratory of the Department of Energy
NGA	National Governor's Association
NREL	The National Renewable Energy Laboratory, a federal laboratory of the Department of Energy
NREL-SEAC	NREL's Strategic Energy Analysis Center
NSF	National Science Foundation
NYSERDA	New York State Energy Research and Development Authority, an agency that performs basic energy research and analysis on a variety of energy issues.
ORNL	Oak Ridge National Laboratory
OSTP	Office of Science and Technology Policy
PAE	DOE-EERE's Planning, Evaluation and Analysis division
PHEV	plug-in hybrid electric vehicle
PMA	power marketing association
PNNL	Pacific Northwest National Laboratory
R&D	research and development
RAP	Regulatory Assistance Project
RD&D	research, development and deployment
RE	renewable energy

REMAP	Renewable Energy Modeling Analysis Partnership – a joint energy analysis modeling forum run by the DOE and EPA.
REMI	Regional Economic Models, Inc. owns and operates a model that quantifies the total economic effects, including new jobs, of transportation improvements
RGGI	Regional Greenhouse Gas Initiative, a cooperative effort by Northeastern and Mid-Atlantic states to reduce carbon dioxide emissions
RPA	Resource Planning Act model created by the USDA to inventory the biomass available in state forests.
RPS	renewable portfolio standard
RTO	Regional Transmission Organization, is a regional organization designed promote efficiency in wholesale electricity markets, so that customers are served at the lowest price possible for reliable service
SEDS	Stochastic Energy Deployment System model is a capacity-expansion model of the U.S. energy market, developed and maintained by NREL.
SEO	state energy office
SMOKE	An air quality model
STAC	State Technologies Advancement Collaborative
TC	technology characterization
USDA	U.S. Department of Agriculture
USDA-CREES	Cooperative State Research, Education, and Extension Service
USDA-OCE	USDA's Office of the Chief Economisst
USDA-USFS	USDA's U.S. Forest Service
VISION	A publicly available, long-term spreadsheet model developed by ANL to look at market entry, energy use and carbon emissions of various types of advanced light- and heavy-duty highway vehicle technologies and alternative fuels.
Wikipedia	A web-based encyclopedia that is written and edited collaboratively by its readers